SCIENTIFIC AMERICAN

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Vol. XCVII.—No. 25.
ESTABLISHED 1845.

NEW YORK, DECEMBER 21, 1907.

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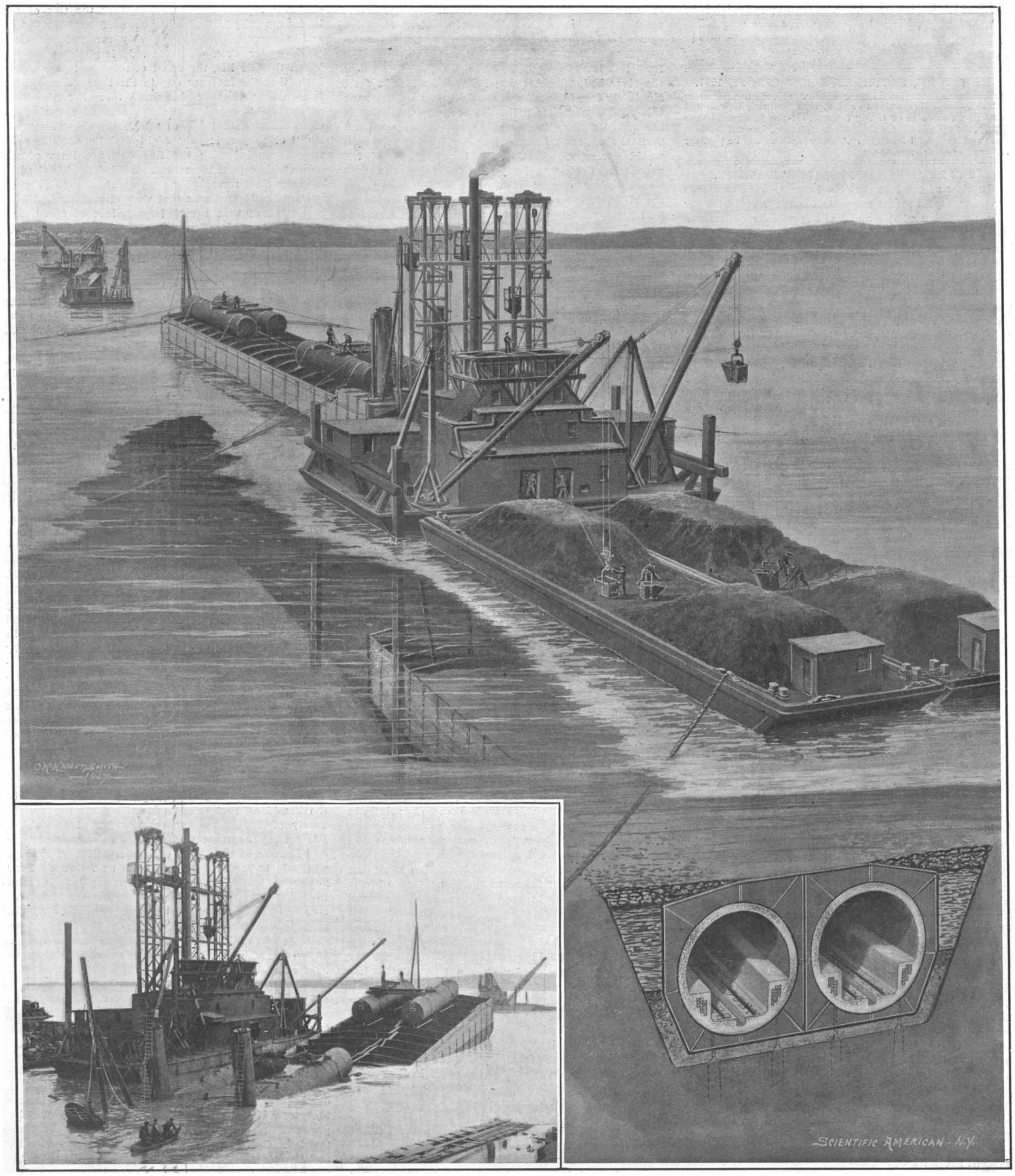

From Left to Right Are Shown the Floating Dredge for Excavating the Trench in the Bed of the River; the Scow Pile-Driver for Driving Piles in the Bottom of the Trench; a Section of the Double Tube in Position for Sinking; the Floating Concrete Mixer from Which the Concrete is Distributed Around the Sunken Tubes; and the Barges Carrying the Sand, Broken Stone, etc., for the Concrete. The Lower Left-Hand Cut Shows a Length of Tubes Being Sunk Into Position in the Excavated Trench.

NEW METHOD OF CONSTRUCTING A SUB-AQUEOUS TUNNEL.—[See page 458.]

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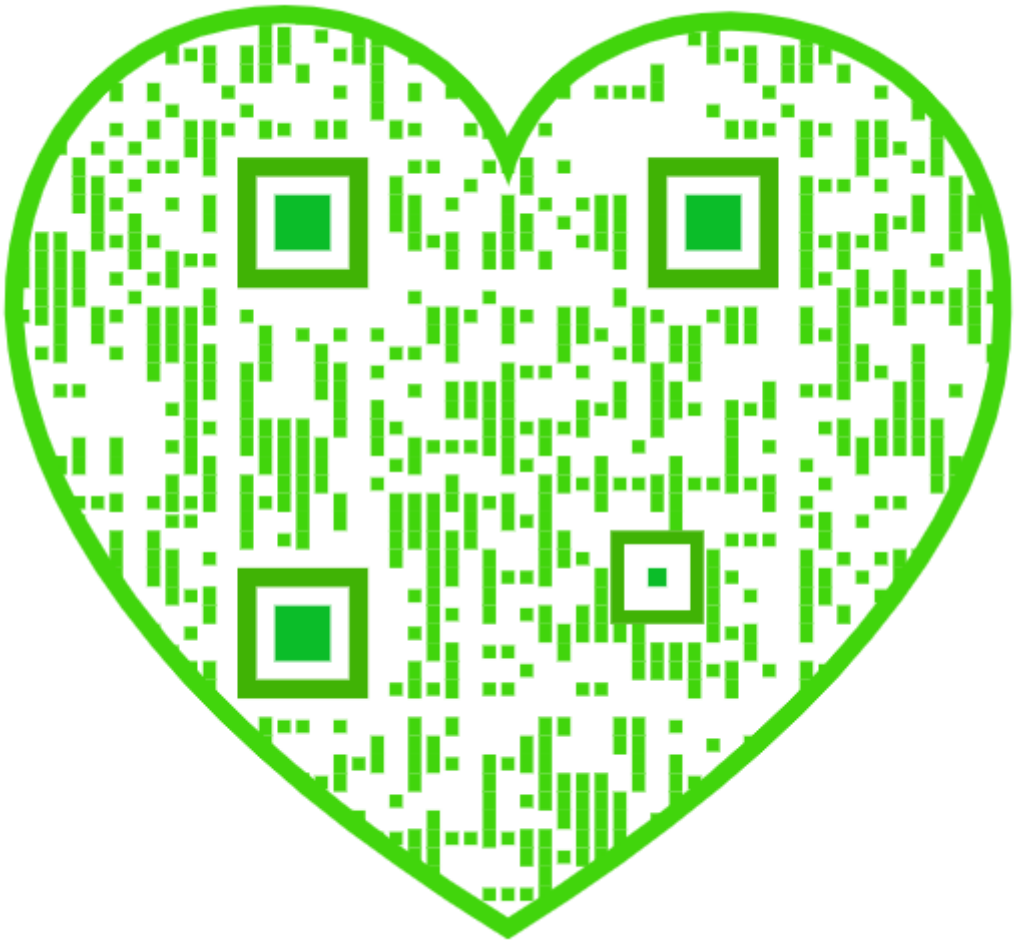

SCIENTIFIC AMERICAN
ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at
No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*
361 Broadway, New York

FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York

TERMS TO SUBSCRIBERS

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Scientific American (Established 1845)..... $3.00 a year
Scientific American Supplement (Established 1876)..... 5.00 "
American Homes and Gardens..... 3.00 "
Scientific American Export Edition (Established 1878)..... 3.00 "

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, DECEMBER 21, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE PRESIDENT ON EMPLOYERS' LIABILITY.

In view of the fact that the SCIENTIFIC AMERICAN is offering a gold medal annually for the best device for the protection of life and limb, it will be understood how thoroughly in sympathy we are with that portion of the President's message in which he recommends the adoption of legislation providing for the compensation for accidents to workmen. That the question is far-reaching and of sufficient magnitude to call for immediate action, is shown by a glance at the statistics of accidents published by various commissions and boards that take cognizance of this matter. Thus, the Public Utilities Commission lately drew attention to the fact that during twenty-six days in August of the present year, 5,500 accidents occurred on the surface roads of New York city alone—which is at the rate of 211 a day, or 77,000 a year. The Department of Health of this city reports that during 1906 there were 3,781 fatal accidents in New York—equivalent to an average of ten a day. That the fearful frequency of these accidents is not confined to New York alone, is shown by the figures of the Interstate Commerce Commission, which reports that in the year ending June 30, 1906, there were 108,324 railway accidents in the United States; an increase of 12,613 over the number which occurred in 1905, in which year the railroads of this country furnished more accidents than all the casualties on both sides during the three years of the Boer war. The total number of accidents in the United States of all kinds, chiefly industrial, in a single year exceeds half a million.

Now, seeing that a large proportion of the deaths and injuries is due directly to the risks incurred by workmen employed in our industries, and that as matters now stand the law affords little or no protection to the workman, who in the majority of cases must endure the results of injury without compensation, it can be seen what a vast injustice is laid upon our industrial workers under existing conditions. It is true that a body of attorneys has come into existence which, in the President's words, exist "only by inciting men who may or may not have been in the wrong to undertake suits for negligence"; but it is a fact that such suits usually "secure only inadequate compensation, and often cause altogether disproportionate annoyance to the employer." The President advocates the passing of a law providing limited but definite compensation for accidents to all workmen within the scope of the Federal power, including employees of navy yards and arsenals. The law should be so framed that the payment for accidents by the employer would be automatic, instead of being a matter for lawsuits; workmen receiving certain and definite compensation for all accidents in industry, irrespective of negligence. The spirit of such legislation would be based upon the principle that the employer is the agent of the public, and that when he starts any industry, he does so on his own responsibility and for his own profit. He sets in motion agencies which create risks for others, and he should, therefore, take all the ordinary and extraordinary risks involved; and the risk he thus at the moment assumes will ultimately be assumed, as it ought to be, by the general public. By the enactment of such a law, the shock of the accident will be diffused, and will not, as it now does, fall upon the man or woman who is least able to bear it. The benefit would be twofold, since employers would gain a desirable certainty of obligation, and would get rid of the present necessity of litigation to determine that obligation, while the workman and his family would be relieved from the too-often crushing load of disablement or death.

It is a fact, unfortunate but undeniable, that in legislation designed to safeguard the life and limb of the individual citizens, we generally are lagging behind the rest of the industrial world. Since the year 1895 practically every country of Europe, together with Great Britain, New Zealand, Australia, British Columbia, and the Cape of Good Hope, has enacted legislation embodying the principle that upon the employer should be placed the entire trade risk in the various lines of industry. Considerations of humanity and of national prestige should lead Congress to take early and effective action to bring our practice at least up to the standard established by the rest of the world.

DIFFICULTIES IN CONSTRUCTING THE GREAT CATSKILL AQUEDUCT SIPHON.

It will be remembered that the plans of the Catskill aqueduct include the construction of a huge siphon for carrying the water below the Hudson River at a crossing near Storm King Mountain. The aqueduct reaches the western bank of the river at an elevation of several hundred feet above water level. The original plans contemplated the sinking of a vertical shaft from this level to a point about 400 or 500 feet below the river bed, where it was believed that solid rock, absolutely free from fissures, would be found. Through this rock a tunnel is to be driven horizontally, until the opposite shore is reached, where it is to meet a vertical shaft sunk from a level above the river, which would correspond to the established grade of the aqueduct. Geologists had predicted that solid rock would be encountered at a depth of 500 feet below the river, and borings were carried on through the past year to ascertain how far this estimate was correct. Much to the surprise of everybody concerned, no solid rock has yet been encountered, although the borings have been carried down to a depth of nearly 700 feet. Although the drills operated from scows in the river have been sunk for hundreds of feet below the river bed, nothing has been found thus far but mud, sand, and bowlders. In view of the fact that the pressure in the 14-foot circular tunnel will reach about 15 tons to the square foot, it is imperative that the tunnel be driven in absolutely sound rock; otherwise, under this pressure, there might be very serious leakage. Investigations of other possible points of crossing have shown there is no likelihood of finding a more satisfactory location than that at Storm King Mountain; for it is believed that the old bed of the river lies everywhere many hundreds of feet below the present bottom. Comparative estimates have been made of the cost of carrying the water across the river by means of steel pipes laid on the present bottom, or by an aqueduct built at high level; but the engineers of the Board have concluded that a deep tunnel through solid rock will, all things considered, prove to be the most satisfactory method of crossing. Apart from the fact that when such a tunnel is once built, there will be no subsequent expense for maintenance, a tunnel siphon would be absolutely safe from injury, a most important consideration where the health and safety of such a great city as New York is concerned.

THE MASTERY OF THE OCEAN.

The first week of December, 1907, will long be remembered as one of the most boisterous in the annals of transatlantic travel. The steamers which made the western passage encountered what was almost a continuous gale, from the time they left the English Channel and the Irish coast until they passed the Sandy Hook lightship. Not only were the winds at times of cyclonic force, but the captains of the various ships agree in stating that the seas were among the heaviest encountered in their experience. The fact that although all of the ships were some days late in arriving none of them received any serious damage, testifies to the high state of perfection which the art of constructing and navigating the modern ocean liner has reached. Of all the ships which made the passage, the greatest interest naturally attaches to the "Lusitania," which, because of her great size and power, would be expected to show superior ability, not only to smash her way at high speed through the heavy seas, but to do so with far less discomfort to the passengers than would be experienced on a smaller vessel. Let it be recorded then, at the outset, that her experience in the boisterous weather she encountered makes it certain that the ship will never be built whose size is such that she will not be more or less the sport of the elements, and whose power will never be so great but her speed will be to some extent cut down by the combined resistance of the wind and sea. But having admitted this much, it was proved in the recent rough passage that increase in size and power contributes enormously to the comfort of the passengers and the average speed of the trip. A length of close upon 800 feet, a beam of 88 feet, and a draft of 34 feet, to say nothing of a displacement of over 40,000 tons, provide dimensions and mass to which even the most furious of Atlantic gales are able to impart only slow and rhythmical movements of pitching and rolling. Although the rise and fall of the bow must at times have been as great as 50 feet, the movement, except on rare occasions, was gradual, and did not involve those sudden changes of position which are so strongly provocative of seasickness. So also the rolling, which rarely reached ten degrees each side of the normal, was very slow, and was accompanied by an appreciable period of rest before recovery. It has been proved in this ship beyond question, that increase of comfort is gained by increase of size, and the future is certain to see a growth in the dimensions of transatlantic ships, whose only limits will be those imposed by the length of piers at which the ships lie, and the depth of the harbor channels through which they must pass.

The 70,000 horse-power, quadruple turbine engines proved to be admirably adapted for driving the vessel into a heavy head sea. "Racing," that bugaboo of the marine engineer, has been practically eliminated. The four propellers are so deeply immersed, and their diameter is relatively so small, that the tips of the blades are fully 12 feet below the surface of the water; and, consequently, they are very rarely lifted clear of the water, even when the ship is pitching heavily. When they do lift, the speed of rotation is already so high, that the increase due to the lessened resistance is scarcely noticeable. Moreover, there is no lowering of the ship's speed, as in the case of a racing reciprocating engine; the thrust on the ship being constant, or subject to only slight variations. This even thrust, coupled with the fine entrance lines of the ship and her great momentum, enabled the "Lusitania" to maintain a remarkably even and high rate of speed against the biggest seas that were encountered. There was none of that severe impact, loss of speed, and subsequent acceleration which mark the performance of a ship driven by reciprocating engines. Consequently, the turbine as a drive for big ships has already rendered itself very popular with the officers on the navigating bridge. During the first heavy gale, which was encountered off the coast of Ireland, the ship was driven into enormous head seas for some hours at a speed of over 23 knots an hour. Ultimately, in spite of her freeboard forward of fully 50 feet, she began to ship green seas, which swept the fore deck, tore loose the derrick booms, and began to batter in the lighter plating of the forward breastworks. Subsequently, for the rest of the trip, she was driven under reduced power, the revolutions being about 157, as against the maximum speed of 180 per minute. This passage proved that if suitable alterations were made forward on the forecastle deck and the bridge structures, in the way of breakwaters and extra heavy scantling, and plating sufficient to stand the impact of the seas, it would be possible to drive a ship of this size with the full power of her engines through any gale which might be encountered and maintain a speed of 23 knots an hour against it. Such a ship, however, must be prepared to take on board and resist the impact of solid green seas, which may be at times 10 or 15 feet deep on the highest forward deck. The navigating bridge of this ship is 70 feet above the water, and yet at times the seas struck the rails and stanchions so heavily as to bend and split them in several places. Probably the best provision for heavy weather would be some form of turtleback deck forward, with the navigating bridge and pilot house carried upon a light framework above it, the forward end of the deck structures being given something of a snowplow shape, with a view to deflecting the seas that came on board, and throwing them clear of the passenger promenades and deck houses.

PROPOSED NEW SHIPS FOR THE NAVY.

The Secretary of the Navy, in his annual report to the President, recommends that Congress appropriate nearly $70,000,000 for the construction of new ships. His recommendations are based upon those of the General Board and the Board on Construction. The ships which it is proposed to build are as follows: Four 20,000-ton battleships of the "Delaware" type, each to cost $9,500,000; four scout cruisers of the "Chester" type, each to cost $2,500,000; ten destroyers of the same type as those recently contracted for; four submarines of the "Octopus" type; one ammunition ship; one repair ship; two mine-laying ships, which are to be formed by the conversion and equipment of two cruisers now on the navy list; and four fleet colliers.

This programme of new construction is designed, in addition to increasing the strength of the fighting line, to strengthen our navy in elements in which, at present, it is somewhat weak, and in which other leading naval powers are moving ahead of us in the matter of construction. At present our navy is deficient in destroyers, submarines, and colliers; for, in building up our battleship strength, we have overlooked the importance of these three essentials of naval efficiency. The proposal to build 20,000-ton battleships is to be commended. Our own experience with our larger vessels, and the consensus of opinion and practice in the leading navies of the world, point to the big one-gun ship as the ideal fighting unit of the immediate future. It will be noticed that there is no recommendation for the construction of either armored or unarmored cruisers. The former has merged into the battleship; the place of the latter is taken by the fast unarmored scout, of which four are recommended in this report.

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It is suggested by the Secretary that the four colliers, a type of ship in which our navy is sadly deficient, be built in the navy yards on the Atlantic coast. The absence of the Atlantic fleet during its cruise to the Pacific will leave our eastern navy yards with very little work to do, and the construction of these colliers on the vacant slips would serve to keep our efficient navy yard forces together until the fleet returns.

The total appropriation is a large one, the largest in fact that has ever been asked for by any Secretary of the Navy for naval increase, at any one time; but we must remember that the nation has been growing in wealth and numbers at a rate which is even greater than the rate of increase of naval expenditures. If our navy is to fulfill its great function of preserving the peace, it must be maintained at a standard of strength commensurate with the interests over which it stands guard.

RECENT AUTOMOBILE ENDURANCE TESTS.

Automobile endurance tests at this season of the year are rather of a novelty, to say the least, so the results of the two which occurred recently, in the East and West respectively, will doubtless interest our readers, especially since all the cars which obtained perfect scores are standard American machines and old-time favorites.

The first test was a decided novelty in the form of a 24-hour road reliability run. It was conducted by the New Jersey Automobile and Motor Club, the conditions being that each machine should make five rounds of a 94-mile circuit in just 24 hours without any adjustments and without stopping the engine except in controls. No running schedule was provided, and but three minutes leeway was allowed at the finish. Students from Stevens Institute acted as observers. The course was an excellent one, there being only one short, muddy stretch and three or four bad turns. Starting from Newark, it passed through Bloomfield, Montclair, Dover, Succasunna, Mount Freedom, Morristown, Bedminster, Somerville, Bound Brook, and Plainfield. The start was at 2 P. M. on November 15, under fair weather conditions. Twenty-one cars started, and a few of them made the first round in a trifle less than three hours, while more than half completed it in less than four. Two Maxwell machines were eliminated in this round, one on account of faulty lubrication, which caused the connecting-rod bearings to burn out, and the other because of carbureter trouble. The Oldsmobile "Mudlark" experienced trouble from a slipping clutch, while a Pullman touring car caught fire and was burned during the refilling of the gasoline tank at Newark.

The next three rounds were made during the night, which was a moonlight one, although very chilly on account of a cold northeast wind. A single-cylinder Hewitt runabout dropped out on the second round, owing to loss of time from running out of fuel in a secluded part of the course. A 4-cylinder Cadillac runabout ran into a bank and smashed a front wheel at about 2:30 A. M. This car was far ahead of the requisite schedule of 19 miles an hour, and notwithstanding a delay of four hours, it finished on time, though penalized 1,098 points for replacing the wheel. One of the new water-cooled Marmon cars was ditched during the night while trying to pass a hay wagon on a narrow stretch of road.

Fifteen machines had started on the fifth round by 9 A. M. of November 16, and seven still had perfect scores. A Maxwell 4-cylinder touring car dropped out because of a leaky radiator, which left but fourteen cars to finish. Seven of these had perfect scores as follows: 40-horse-power Ford 6-cylinder runabout (the only 6-cylinder car in the contest), 28-horse-power air-cooled Franklin touring car, 50-horse-power Haynes runabout, 20-horse-power Locomobile touring car, 20-horse-power Matheson touring car, 30-horse-power Oldsmobile touring car, and 50-horse-power Thomas touring car.

Seven cars were penalized, although most of these finished on time. A single-cylinder Cadillac hit a tree in the night and stalled its engine, for which it was penalized 23 points. Its 4-cylinder mate received 1,098 points. Grout, Autocar, and Mitchell machines were penalized 107, 76, and 115 points for adjustments *en route*. Two other Mitchell cars abandoned the test, one of them on account of a broken water pump. The new 4-cylinder water-cooled Marmon touring car also did not finish, while its air-cooled mate, driven most of the time by a woman, finished nearly on time with 341 points penalization, caused chiefly by a leaky petcock in the gasoline system. The Oldsmobile "Mudlark" (a 30-horse-power 1906 touring car) received 12 points on account of a slipping clutch.

In summing up the results of this test, it is to be noted that exactly one-third of the cars finished with perfect scores, a second third finished with penalizations, and the remainder abandoned the test because of breakdowns or accidents. The test was not a particularly strenuous one for the machines, though it showed their ability to keep going for twenty-four hours on good roads. It was more a test of the physical endurance of the drivers than of the mechanical endurance of the cars, as almost without exception the drivers remained at their wheels throughout the entire run. Nevertheless, the test has shown the possibilities in a contest of this sort in the way of finding defects within a short period of time, and it is probable that similar tests over rougher roads will be held in the future.

The second endurance test was held under the auspices of the Chicago Motor Club, and consisted of three runs of about 200 miles each, made from Chicago to cities about 100 miles distant. The cars were divided into three classes according to a price classification, and were required to make 20, 17, and 14 miles an hour respectively. At the end of the road test the cars were submitted to the close scrutiny of a committee of technical men, and any breakages or slight defects in them or in their accessories counted against them. It was this latter part of the test—the final inspection at the end of the road trial—that brought penalizations to a number of leading makes of cars. It was, indeed, hard that after a strict 600-mile endurance test a car should be deprived of a perfect score on account of the looseness or slight breakage of some accessory, such as a lamp, speedometer, or horn; and in this respect, the rules were rather too strict than otherwise. If they had been made to apply to the shaking loose or breakage of any parts of the car proper, this would have been sufficient.

In the first day's run of 230 miles from Chicago to South Bend and return, 35 cars started. Four of these dropped out during this run, one of them, a Thomas Flyer, becoming ditched on account of fast driving before it got beyond the city line. A Royal Tourist broke its rear axle before it had traveled 25 miles. The driver succeeded in obtaining a new axle from Chicago and putting it in place on his car. Altogether he lost 4¾ hours, but he managed to make half of this up before the end of the day. A Marion machine also broke an axle, while a Frayer-Miller cracked its frame. Other cars which were penalized were a Matheson (which lost 235 points owing to trouble with a radius rod, and 16 points for tying up the sprag to keep it from dragging); a Maxwell (which lost 334 points from engine trouble, though it made all controls on time); and the Locomobile and Pierce machines (which lost 10 and 26 points respectively from making brake adjustments).

The second day's run was from Chicago to Rockford and return, a distance of 189 miles. The roads were much better than those encountered during the first day's run, and the contestants found many stretches where they were able to make high speed. Several new machines were penalized on this day, while others which already had points against them secured some in addition. At the start of the third day's run, one of the three Matheson cars lost 401 points on account of the driver finding it necessary to open the bonnet and pour warm water on the carbureter before he could start the engine. The car was withdrawn from the contest, despite the fact that it had a perfect record up to this time. A third Matheson car, and a Stoddard-Dayton 6-cylinder car did not start on this day. The run was to Ottawa, Ill., and return, a distance of 205 miles. The cars which were penalized on this day were rather few. The Pierce machine, which was penalized 26 points on the first day, made the following two runs without further penalization. The Wayne roadster collided with a Maxwell touring car and broke its steering knuckle, while the Maxwell, which had encountered much hard luck throughout the test, lost no less than 610 points. The Rapid 'bus, which carried twelve people, received 66 points penalization in the third day's run. This machine made a remarkable performance, however, for although it was mounted on solid tires and propelled by a simple type of double-opposed-cylinder engine, it was able to keep up to the schedule. In one instance the driver lost his way and, in order to get back on the course, he was obliged to go across country on a flooded dirt road, which was very hard to travel. The machine made its way without shedding a passenger, however, and finally arrived ahead of its schedule. The performance of this machine has thoroughly demonstrated the reliability and usefulness of the modern light-weight commercial vehicle for cross-country work.

At the conclusion of the road test, and after the committee had examined and marked the cars, there was only one machine—a 30-horse-power Haynes roadster—which was found to have a perfect score. The runabout body was on a chassis like that which participated in the Glidden tour last summer, and which has been in different contests throughout the year. Its designer, Mr. Elwood Haynes, is one of the oldest and most competent builders of automobiles in this country, and the winning of a perfect score in this contest (which secured him the Miles trophy) is an honor which he well merited. The machine which obtained second place, and thereby won a silver set, was a 6-cylinder Pierce touring car, which was penalized two points at the conclusion of the test, on account of its having a loose grease cup on the rear axle. An Oldsmobile touring car was third. It had six points penalization, four being given for a loose boot on the driving shaft, and two for the adjustment of the emergency brake, which was, according to the ideas of the committee, not adjusted tight enough. The fourth machine was a Rambler, which was penalized 8 points as follows: Pedal brake medium, 2; lamp damaged, 4; speedometer loose, 2. An Auburn touring car, which is a light 4-cylinder machine made in Chicago, came the nearest to the Haynes of any machine in securing a perfect score, as it was penalized 10 points on account of the wheels and spindles being slightly out of line. This might have been due to an error in the first measurement. The distance out was small, being only a fraction of an inch. Such standard machines as a White and a Locomobile were penalized 6 and 2 points for a loose running board and a loose fender, respectively. The former also lost 6 points because of a loose apron and the latter points as follows: Fan belt off, 2; emergency brake, medium, 2; grease cup loose, 6; speedometer loose, 2; total, 14.

Most of the other cars suffered chiefly from similar small troubles. A list of those that finished, together with the points which they were penalized, follows:

Studebaker, 16; Kisselkar, 18; National, 26; Silent Knight, 54; Pierce Arrow, 55; Jackson, 66; Locomobile, 67; Autocar, 74; Premier, 78; Dragon, 90; Stoddard-Dayton, 107; White, 110; White, 137; Stevens-Duryea, 186; Rapid 12-passenger 'bus, 188; Wayne, 620; Reo, 1,040; Maxwell, 1,108.

Still another midwinter sealed-bonnet contest of a very strenuous character was run by the Automobile Club of Washington, D. C., on the 10th instant. This test was carried out over a 118-mile course in a heavy rainstorm. It had been raining heavily for two days, and the roads were in very bad condition. Despite this fact 22 cars finished, 16 of them with perfect scores, out of 26 which started. A double-opposed-cylinder Buick made the fastest time, covering the entire course in 8 hours and 1 minute, at an average speed of 14½ miles an hour. The cars that had perfect scores were as follows: Buick, Cadillac, Columbia, Corbin, Ford, two Franklins, Locomobile, Maryland, Maxwell, two Mitchells, Oldsmobile, Packard, Thomas, and a Wayne.

THE MOTOR BOAT SHOW AT THE GRAND CENTRAL PALACE.

The motor boat exhibit, which was held last week in the Grand Central Palace in this city, showed nothing radically new for 1908. There were a number of large 40-foot cruisers and pleasure craft with elaborate cabins on exhibition in the main hall, while the exhibit of engines and accessories in the spaces around this hall was that which attracted the most attention.

The craze for speed, which was predominant a few years ago, seems to have died out, and practically all of the craft shown were intended for comfort and pleasure rather than for racing. A favorite type seems to be the hunting cabin launch, which type of boat has an inclosed cabin projecting above the deck at the forward end and followed at the stern by an open cockpit. Among the smaller boats shown were several launches of moderate cost. The only racing craft exhibited was the "Den."

Among the large engines displayed were the Craig motor, used in the boat "Ailsa Craig," which won the Bermuda race last spring. The small 2-cycle engine was to be found in large numbers. The tendency in the design and equipment of this type of motor seems to be the lightening in weight of the engine, and the fitting of it with positive oil feeds supplied by gravity or by a mechanical lubricator.

The reversing gear is another part of the motor boat which has received special attention. There were a half dozen different types of clutch and reverse gear shown. Most of these employed metal-to-metal clutches and spur planetary gears. One improved device of this sort made use of a jaw clutch with coiled springs arranged to take up the shock when the clutch is thrown in, while the reverse is obtained by friction disks, which are forced in contact with disks on the driving and driven shafts respectively. Several improvements were noted in the method of starting the motor. One starting device consisted of a crank placed beside the tiller, and connected through a chain to a shaft running along in the bottom of the boat to the motor. Another arrangement of this kind consisted of a crank placed back of the motor, and made to turn it through gears which gave a considerable reduction, thus making it possible to start the motor without relieving the compression. The arrangement in the steering wheel of the spark and throttle control levers, similar to that used in an automobile, also seems to be quite general.

There were a large number of accessories, such as exhaust-operated whistles, electric lights, ignition dynamos and batteries, etc., on exhibition. One of the most novel of these was a speed indicator, which is claimed to show at any moment the speed at which the boat is running.

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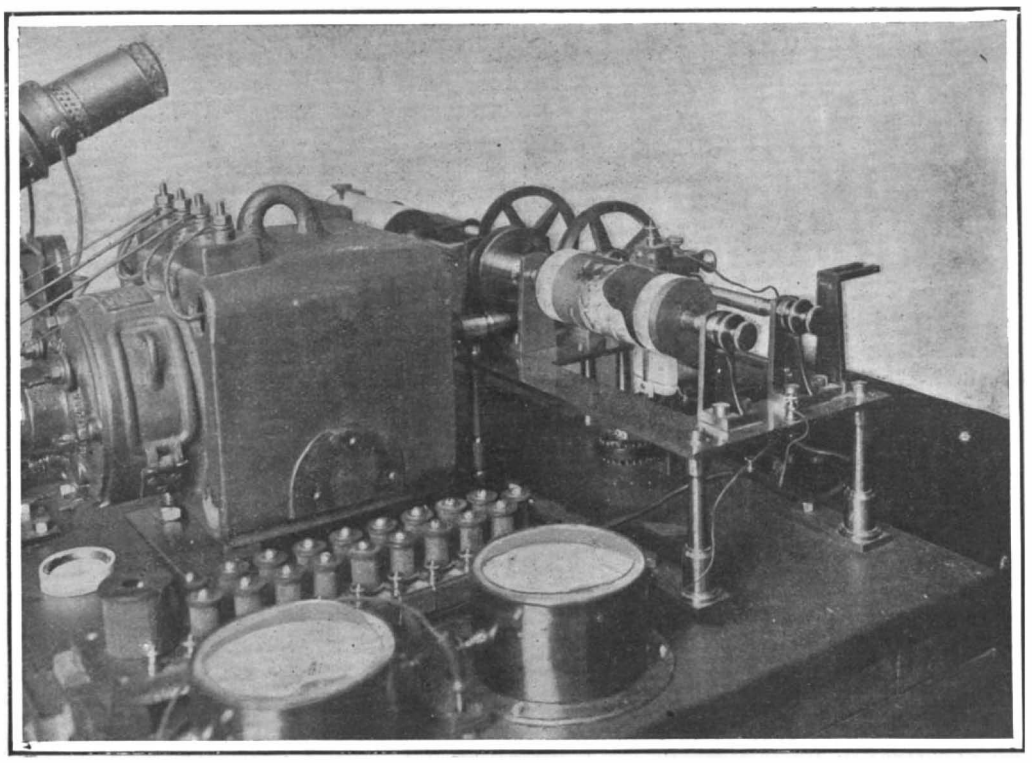
THE BELIN PROCESS OF TELEPHOTOGRAPHY.

BY JACQUES BOYER.

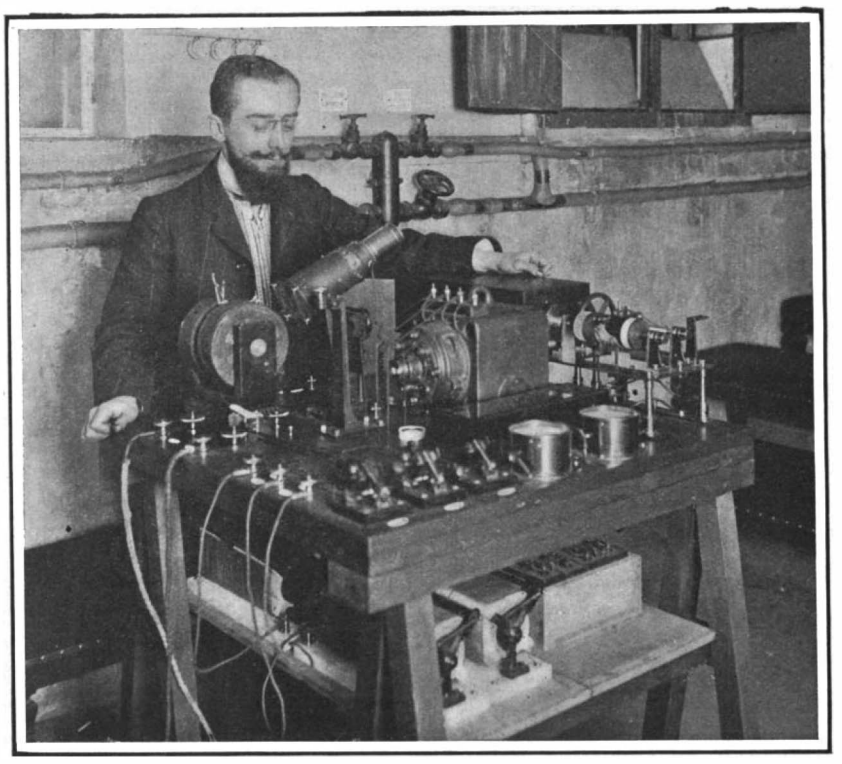
With the apparatus of Prof. Korn, of Munich, described in these columns, only photographs of faces can be transmitted to a distance, since pictures of busts and landscapes give poor results, owing to insufficient distinctness. This problem, however, has been solved in a much more perfect manner by a Frenchman, M. Edouard Bélin, as has been shown by the experiments performed by him in the laboratory of the Societe Française de Photographie. The transmitting apparatus of this ingenious inventor is wholly mechanical in all its details. A carbon print of the photograph to be telegraphed is placed on a revolving cylinder, while a stylus traveling over this print imparts to the line conductor by means of a lever current differences corresponding with the differences of relief through a rheostat.

In transmitting, the picture is rolled on a horizontal cylinder of metal. The picture consists of a carbon print made on rather thick paper, and presenting a relief proportional to the intensity of the colors of the picture. This difference of level, almost unnoticeable to the touch, is, however, sufficient for a point in gliding over the cylinder to respond to the differences and to transmit them in movements of a corresponding amplitude to the extremity of the arm of a lever. When the cylinder is turned, the fine sapphire point of the stylus passes over the entire surface of the picture, following spiral lines one-sixth of a millimeter apart. The differences of relief of the picture are translated into movements at the other end of the lever, and by means of a little slider on a rheostat connected with the line, currents of an intensity proportional to the amplitude of these movements and therefore the corresponding colors are sent.

In receiving, the apparatus follows the same general principles as that of Prof. Korn. As already described in these columns, Korn has made a receiver in which a beam of light is projected on the sensitized surface upon which the impression is to be made through a galvanometer in which a little sheet of aluminium forming a shutter is displaced more or less according to the intensity of the currents transmitted by the line, communicating to the luminous ray corresponding intensities. In the receiving apparatus of Bélin we find the same source of light produced by a Nernst lamp, but the galvanometer is supplanted by an apparatus known as the Blondell oscillograph, from the name of the inventor. This oscillograph is made up of two large coils between which oscillates a very small mirror scarcely two or three millimeters in diameter, and of an extreme sensibility of movement. The movements of the mirror, like those of the aluminium sheet of Korn, are strictly proportional to the intensity of the received current. The ray coming from the Nernst lamp reflected by this oscillating mirror is projected on a lens, where it produces a luminous line which is displaced more or less from right to left, according to the oscillations of the mirror. Opposite this lens, a sheet of glass is placed, called the "color scale," tinted gradually from right to left, from black to absolute transparence. According to the zone where it is projected, the luminous ray is colored more or less, while the lens on whatever point of which it falls focuses it back to the fixed point where it impresses itself upon the photographic paper. This paper is rolled upon a cylinder contained in a dark chamber and is displaced before the point of light with a rotary motion, identical, with the exception of the correction for synchronism, to that of the sending station. To avoid spreading of the luminous



The Transmitting Apparatus in Detail. The Picture is Wrapped Around the Cylinder Seen in the Engraving.



The Inventor and His Apparatus in the Laboratory of the Société Française de Photographie.

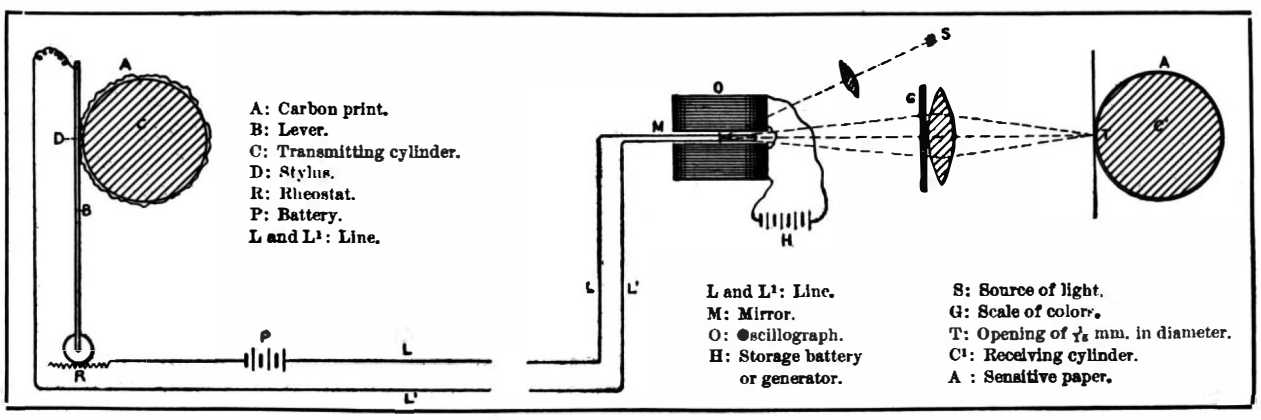
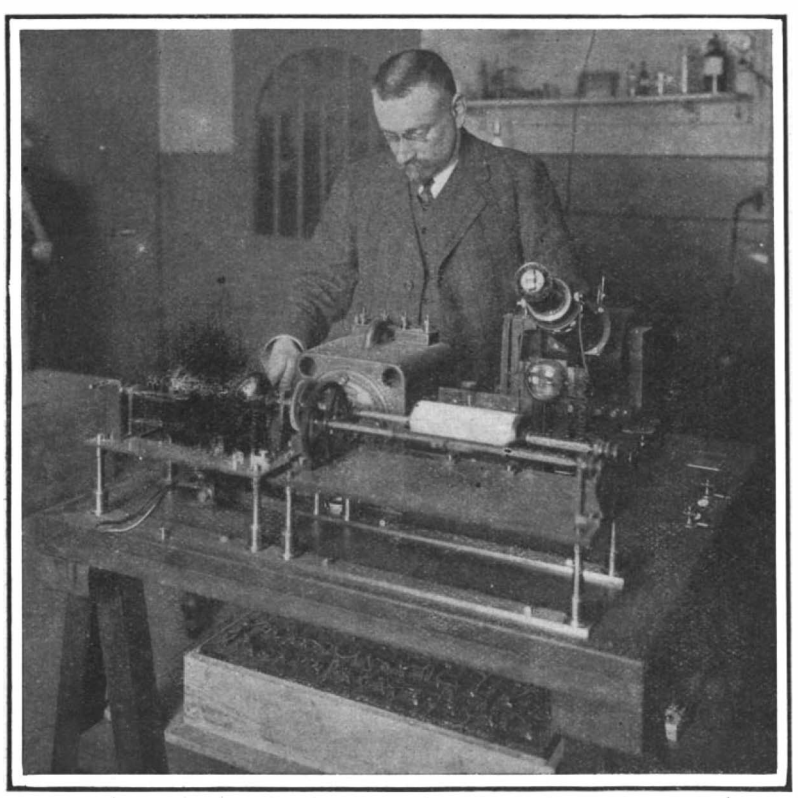


Diagram Showing Electrical Connection of the Parts Comprising Bélin's Apparatus.

Outdoor Picture Especially Made for the Scientific American.



Receiving Apparatus With Inclosing Box Removed to Show the Mechanism.

Portrait of the Inventor M. Bélin Transmitted With His Apparatus.

THE BÉLIN SYSTEM OF TELEPHOTOGRAPHY.

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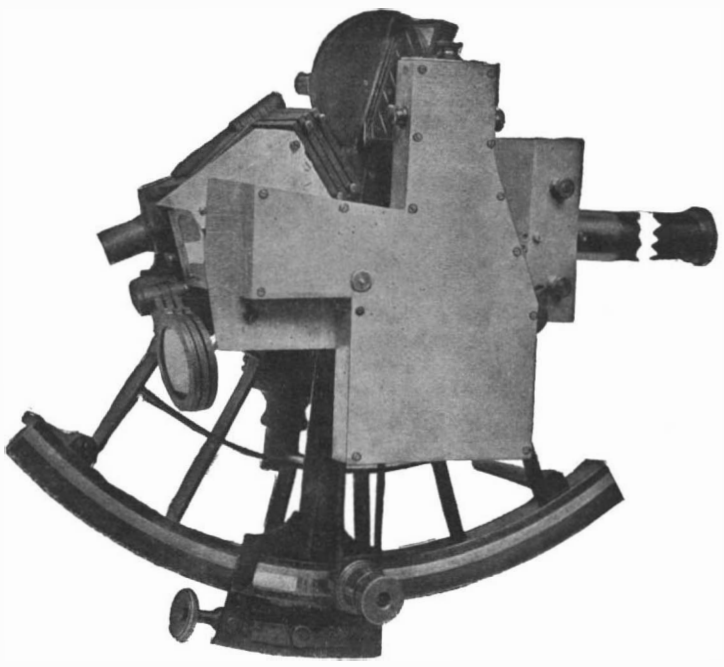
ray so as to produce a halation around each point, which would cause a lack of distinctness in the picture, the cylinder almost touches the wall of the dark chamber in which is pierced the extremely small hole through which the luminous ray, reduced to a surface of one-sixth of a millimeter, enters. The inventor can, at will, obtain a print sent as a negative or as a positive, whether it comes from a transmitting positive or a transmitting negative. It is merely necessary to transpose the color scale so that the ray of light may be tinted in a manner directly or inversely proportional to the intensity of the current and that of the colors sent. It is equally possible to receive a print of a desired tone, whether it comes from a picture either normal, too feeble, or too intense, by employing color scales of a proper transparence. Finally, enlargements can be made by replacing the receiving cylinder with another of larger diameter. In the demonstrating apparatus here shown, a transmitting and a receiving station are mounted on the same table and worked by the same electric motor. Hence, they need not be adjusted for synchronism, as the inventor intends to do later. The imaginary line which unites the two stations is represented by a series of coils, consisting of a resistance equivalent to a line of about 750 miles in length.

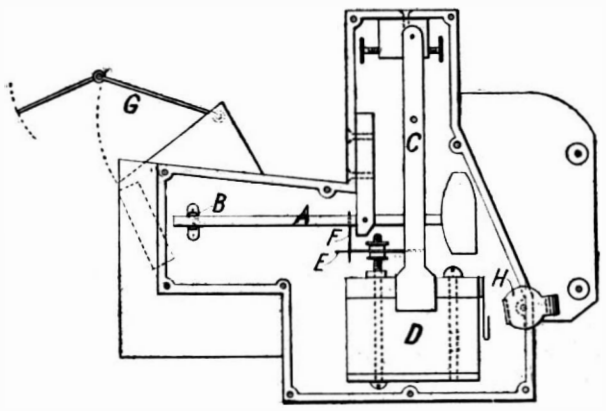
AN ARTIFICIAL HORIZON FOR SEXTANTS.

An artificial horizon for sea use has been wanted for the last hundred years; in fact, ever since the sextant came into general use. It is a matter of common occurrence for mist or fog to obscure or shroud the horizon and thus render an observation impossible though the sun or the stars be in plain view. Many efforts have been made to provide a substitute for the natural horizon. A few of these are based on the principle of the gyroscope, or the pendulum; but the vast majority use a liquid to fix the horizontal. Such devices have failed for shipboard use, because they are seriously disturbed by the slightest movement of the vessel. The fact is often overlooked that as the sextant is a double-reflecting instrument each degree of the circle is represented by two degrees of arc and, therefore, every motion of the head of the sextant doubles the motion of the reflected image both in speed and extent. Hence, the requirement that contacts of heavenly bodies be made on the exact center of a bubble or other indicator of the horizontal is a feat that only the exceptionally steady few may accomplish; but even they cannot maintain such contacts long enough to be perfectly sure of their measurements.

In the accompanying engraving we illustrate an attachment for sextants which is adapted to overcome the usual difficulties. An artificial horizon is provided which consists of two bars that exactly span the periphery of the sun's image in the horizon glass, and are maintained in horizontal position by means of a pendulum forming part of the attachment. This is shown in detail in the line cut. At *A* is a pivoted balance beam which carries the horizon bars *B*, the latter extending through a slot in the casing. The pendulum comprises a pair of plates, *C*, pivoted to a block at their upper ends, while their lower ends carry a heavy weight, *D*. A plate, *E*, is secured to the weight, *B*, and is formed with an opening through which extends a rod, *F*, projecting from the beam, *A*. The pendulum maintains its vertical position when the sextant is held in the hand, and by means of the rod, *F*, the horizon bars are kept at a proper horizontal level. The faults justly attributed to a pendulum when hung to the bulkhead or other fixture of a ship, do not prevail when it is suspended on an instrument in the grasp of a human pendulum who intuitively beats time to the movements of the vessel beneath him and maintains an upright position. The attachment adds about ten ounces to the weight of the sextant; but this is by no means an objection, as it tends to steady the hand of the observer. However, the principal feature of this attachment is the double-barred horizon or "spanner" horizon, as it has been called. If contacts are not properly made, that is, if the contact be too "hard" on either leg of the spanner,



SEXTANT WITH ARTIFICIAL HORIZON ATTACHMENT.



DETAILS OF THE PENDULUM ATTACHMENT.

the error will be seen by the absence of contact on the other leg, and also by the orb being unequally divided by a wire which is stretched centrally between the bars. In fogs when the sun's limbs are not defined, a fair approximation may be obtained by centering the dim circumference. When quick-flying scud or slow-moving clouds obscure first one limb of the sun and then the other, its rise or fall is readily perceived on the respective legs of the spanner. At night the central wire may be used for observations. The spanner is protected against the wind by a casing of aluminium and a shutter *G* serves to protect the horizon glass from rain or spray. The attachment is the invention of Capt. Henry A. Gadsen, of 6 Binden Road, Ravescourt Park W., London, England.

MEXICAN FIESTAS.

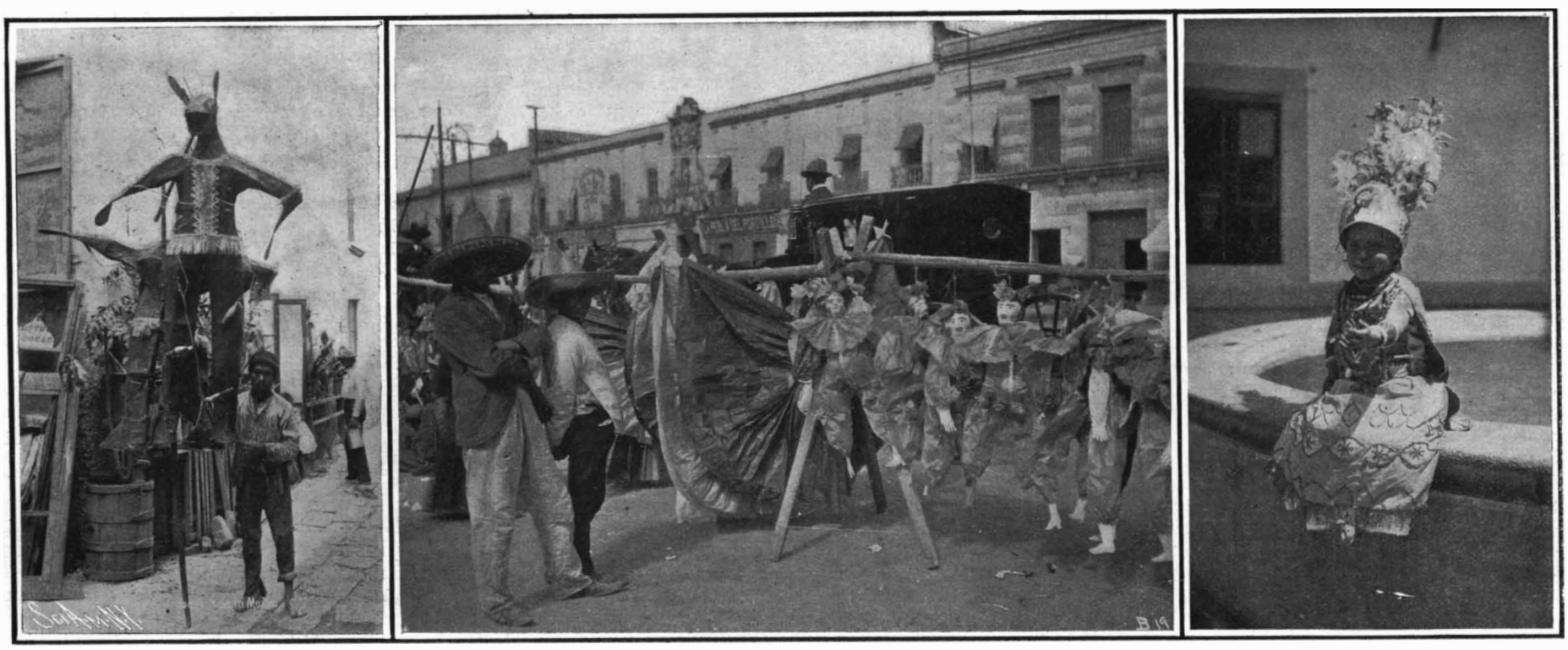
BY KATHERINE LOUISE SMITH.

Mexico is a great country for festivals and saints' days, and on such occasions the streets are filled with crowds of good natured people—many of whom are the peons or working class—who jostle each other (though they never fail to apologize for doing so), and throng the little markets buying souvenirs for friends. In particular, Christmas time is a gala occasion and all Mexico turns out to buy curious things unheard of in other countries. These people make a specialty of odd and curious toys and one can take a choice of bears that dance when a string is pulled, woolly monkeys, Chinese-like lanterns, confetti, and candied fruits. These are piled in a jumble on little tables to tempt the customer. Queerest of all the toys are the *naguales*, dolls with a woolly body and a grotesque human face. They are hideous productions which are supposed by the children to have magical powers over evil and to ward off Satan, a belief shared by many of the Mexican Indians of older growth who live in shut-in portions of the country.

The strangest sight in the Mexican market at Christmas time is the *piñata*. This is a queer figure two to five feet high, built on a bamboo frame. Sometimes these incongruous images represent clowns, fashionable women, or unheard-of animals, but they are always fat-bellied, with a form cut out of cardboard and the center or torso made of an *olla* or bowl. These odd figures are suspended by strings from the head and are dressed in gay silks or tissue paper. It is a common thing to see an Indian or a high-class citizen walking through the streets with one of them suspended from his shoulders. When the *piñata* reaches home it is suspended in the *patio* and on Christmas night it is given a blow in the stomach by the youngest child in the family. Rattles, dolls, toys, and many things to delight the little ones fall out and the secret of its corpulency is revealed. No family is too poor to have one and it takes the place of our Christmas stockings.

Mexicans are exclusive and it is a mark of honor for a stranger to be invited to a *posada* or family party. These are held by the richest and poorest and last from the 16th to the 24th of December. The word posada means an abiding place or inn and the custom originated from the fact that Joseph and Mary journeyed nine days before the birth of Christ. Every night they were obliged to seek shelter. On the evening chosen for the religious celebration—which is usually the 9th—after merry-making on the preceding eight evenings, the friends and servants arrive and the family priest reads mass in a room in which is an altar. Over the altar hangs a picture of the Virgin. Below is a model of a stable and images of the Holy Family. These statues are onyx or clay, according to the means of the family.

After mass has been said every man, woman, and child who attends the posada walks with candle in



A Mexican Judas. Venders of Christmas Piñatas. Dressed for the Carnival.

MEXICAN FIESTAS.

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hand in solemn procession from cellar to attic. The figures of Mary and Joseph are borne reverently in front, and the worshipers intone the litany as they proceed, pausing at doors to beg admittance just as Joseph and Mary did over nineteen hundred years ago. When the litany is finished a few enter a room and the others sing to an ancient chant:

"In Heaven's name I beg for shelter,
My wife to-night can go no further."

This is supposed to be Joseph's plea, and those within the room answer:

"No inn is this, begone from hence,
Ye may be thieves, I trust ye not."

After knocking at many doors and chanting this indefinitely the party at midnight reaches a room chosen for the conclusion of the ceremony. Often this is the roof, for Mexicans learned to use that part of the house long before we had roof gardens. Here is a sort of stable and in it the images of Joseph and Mary are reverently deposited. Care is taken that this part of the posada takes place just as the bells of the churches begin to ring in Christmas morning. All the ramifications of a family are bidden to this semi-religious festival, and each year one house of a family circle is chosen for the celebration. The ceremony is the same, no matter what the station of the people.

Mexico City has another *fiesta* at Carnival time, which, while it cannot compare with those in Rome and New Orleans, is well worth going to see. On Ash Wednesday every good Catholic woman wears somber black, which is at all seasons the favorite church costume. At this time devout people have a cross marked in ashes on their foreheads, and as this is done in the early morning by the priest and is seldom washed off, it lingers for some time as a sort of humiliation. The Saturday before Easter all this penance vanishes and students and young people parade the *paseo* or avenue dressed in old Spanish costumes and as clowns. A most curious custom takes place on this same day, for Judas is burned in public. It is said this strange performance is peculiar to Mexico, and at any rate it seems unique to strangers.

All over the streets of the large cities and villages are hideous paper dolls from two to five feet in height, stuffed with straw and containing coins, fireworks, and bread in their stomachs. These images are strung across the street, in courtyards, in parks and any convenient place and present a remarkable sight. They are homely and crude and are supposed to represent Judas ready for punishment. When all is ready the bells of the cathedral, which can be heard for miles around, peal forth, the other churches take up the chimes, and by 10 o'clock Saturday morning the whole town is ready to turn out to burn the numerous effigies and in this way punish Judas for his treachery in betraying Christ. As soon as the figure begins to ignite, the poor who have taken their station underneath rush forward for the coins and bread, and a great scramble ensues. Sometimes Judas represents an unpopular man and it seems a great relief to burn his effigy. Free fights ensue for the contents of Judas's stomach and the carnival ends in a small riot.

The Jockey Club of Mexico City is the richest and most exclusive club in the republic. It is housed in a dwelling made of tiles, designed by Count Orizaba, who brought the glistening bricks from Spain, and the fashionables of the city belong to it. For many years they had the most elaborate Judas in town. On one occasion it was mounted on a horse whose accouterments, saddle, stirrups, etc., were made of embossed leather. Judas was dressed in an expensive and gaudy suit, with tight fitting trousers decorated with silver coins up the side, and gold-embroidered felt sombrero that cost in the neighborhood of fifty dollars. Of course the populace went nearly wild over such an exhibition, and when the match was lighted and it was discovered that Judas's interior anatomy consisted of fireworks that exploded with a terrific noise and made the sky lurid for miles around, the peons started such a free fight that the police were obliged to ask the Jockey Club to discontinue such exhibitions.

Another *fiesta* day is All Saints', when the cemeteries are filled with people who camp out, put flowers on the graves of their dead, and eat picnic lunches on "the dead tables" spread for the occasion. In some places ices are molded in the shape of skulls, and though the people do not intend to appear festive the occasion seems somewhat like a party to the bewildered outsider.

Dates Thrive on Colorado Desert.

Recent experiments made at the government farm at Mecca, Arizona, with the date palm have proved that dates can be cultivated on the Colorado desert with equal the facility reached in the Sahara desert, from which the palms for the 15-acre Mecca farm were brought.

Although this farm has been in cultivation for only three years, already the palms are bearing well; and this season contain from one to three branches of dates, each bearing upward of twenty pounds.

A year ago it was believed the Salton Sea was to overflow and submerge the Mecca farm, and the government officials purchased ten acres of land near Indio, to which the Mecca palms were to be removed. The water was stopped, however, and now the two farms will be utilized, suckers from the Mecca farm plants being transplanted at Indio.

Of the ten or more varieties there, some are very rare, and as soon as they come into their full bearing it is proposed to establish a packing house, and experiments with packing and shipping the fruit will be conducted on an extensive scale.

THE DETROIT RIVER TUNNEL.

BY JAMES COOKE MILLS.

In a very little while, measured by the swift flight of time in this era of rapid solution of transportation problems, the huge railway car ferries on the Detroit River will have passed from the traffic life of the busy stream. For many years these powerful steamers have transported the enormous freight tonnage and millions of travelers across the border between the two countries. The five trunk lines—the Michigan Central, the Grand Trunk System, the Wabash, the Père Marquette, and the Canadian Pacific—operate no less than ten of these car floats.

When the Detroit River tunnel, one of the most important railway enterprises of the present time, is completed, the through "limited" and express trains and the long heavy freights of all the trunk lines will pass below the bed of the river, and rise to the surface of another country in six to seven minutes. By the present system, about thirty minutes is lost in ferrying and switching each express train, and from four to seven hours in handling through freights; while perishables, which are given the preference over all other classes in quick ferriage, do not get under way again within three hours. In winter, when the ice floes, brought down from Lake St. Clair by the swift current, often jam the river from bank to bank, the big steamers frequently become fast in the stream; and the delay from this cause to fast passenger service between the East and the West sometimes amounts to from three to twelve hours.

The saving in time and expense of operation in moving the heavy traffic across the river through a double-tracked tunnel, over the slow and uncertain ferry system, is deemed by the Michigan Central officials, in view of the ever-increasing tonnage of the road, of sufficient moment for the expenditure of $10,000,000 in the construction of the international tunnelway. About three years ago the project was taken up by Mr. Henry B. Ledyard, then president of the Central, and through his untiring efforts the board of directors authorized the construction of the tunnel, and also the organization of the advisory board of engineers to carry out the great undertaking. The advisory board was appointed in June, 1905, and was composed of W. J. Wilgus, then chief engineer of the New York Central and in charge of the electrification of the New York city terminals; H. A. Carson, consulting engineer, who designed and built practically all of the Boston subways; and W. S. Kinnear, chief engineer of the tunnel in charge of construction.

Instead of digging parallel bores through the tough blue clay far below the bed of the river, by means of shields driven by hydraulic rams, a great trench has been dredged out of the bottom of the river, in which are being sunk successive tubes of steel, 23 feet in diameter and 260 feet long, secured together by transverse stiffening diaphragms of steel at every eleven feet of their length. These tubes form the waterproofing of the tunnel proper, which consists of a solid ring of concrete, two feet in thickness, formed within the tubes. The width of the river between dock lines is about half a mile, and the subaqueous section of the tunnel, or part entirely under the river, will consist of ten of these twin tubes with a total length of 2,622 feet. Along the bottom of the trench, rows of piles have been driven and capped, to form a bearing for the tubes.

The tubes are built at the shipyard of the Great Lakes Engineering Company at St. Clair, forty-eight miles away. The ends of the tubes are "plugged" with stout wood bulkheads, to render them watertight. Then they are launched into the river sideways, very much as lake ships are launched. Floating lightly on the water, and drawing no more than six feet, the tubes are towed by a tug down the river to the place where they are to be sunk. On top of the tubes and near each end are two air cylinders, ten feet in diameter and sixty feet long, strapped securely to the tube diaphragms, and these serve to regulate the settling of the tubes, as they slowly fill with water, which is admitted at the will of the engineers through gate valves in the bulkheads. There is also provided at each end a detachable upright, firmly braced to the section and of sufficient length to indicate the position of the tubes when they have been entirely submerged. These uprights also show the engineers the exact position of the tubes when they are resting on the piling, eighty feet below the surface of the river, and act in adjusting them in their position laterally, so as to bring the sections into alignment. The uprights extend about ten feet above the water when the section is in place. After all is prepared and proper precautions have been taken to check the least deviating movement, the gate valves are opened, and the tubes slowly settle into position.

Each tube as constructed in the shipyard is provided at one end with a sleeve, which is slipped over the end of the adjoining tube already sunk and in position. The sleeve is fitted with a flange, which is bolted to a corresponding flange of the other tube, a rubber gasket being placed between the two. A similar gasket is slipped in at the inner end of the sleeve, bearing up against the edge of the other tube. When the bolts are in place and all is ready, divers turn up the nuts, thus squeezing the rubber gaskets together between the ends of the tubes to form a tight joint. An annular space of three inches by eighteen inches is thus formed all around the tube at the joint, which is then filled with a grout of pure cement. To this end each sleeve is provided on the top with two small pipes, flexible at the joints and leading up to the cement scow floating above. The water in the space is then pumped out, and if the least leak occurs in the main joint, there is more work for the divers in bolting up. When the joint is absolutely watertight, pure cement is pumped into the space through one pipe and continued until it comes out through the other, which is evidence that the space is completely filled.

The water in the tubes is now pumped out and the inner bulkheads removed, leaving the space clear and dry to the outer bulkheads. Concrete gangs now come on the scene, and, pushing their big half circular wood forms along into the new tubes, proceed to build up the tunnel itself, which is of solid concrete varying in thickness from two to five feet. The concrete tube is calculated to be of sufficient strength to withstand all strains and vibrations of the heaviest trains, the steel tubes serving as waterproofing protection, while the outer covering of concrete in turn is the steel tube preservative. On each side of the lower section of the tubes there are benches of concrete four feet high and two and a half feet wide at the top, to serve as passageways and places of refuge for the trackmen. When the concreting is completed there is a clear head room of eighteen feet from the tops of the rails to the center of the arch.

Out in the stream are the cement scows, fitted out with the latest concrete mixers and with huge cranes and other devices for the rapid handling of the material from the lighters alongside. The scows are anchored as immobile as is possible in the swift current of the river, which is constantly churned into choppy waves by hundreds of passing freighters and excursion and ferryboats plying the busy stream. By means of hoppers placed at the top of long vertical delivery pipes, the concrete, as it is prepared, is deposited in the trench exactly where it is needed, and comes in contact with the water only when it is spread over the surface of the gravel bed which was prepared for it. As the work goes on, the concrete is held in proper form about the tubes by three-inch oak planking, firmly braced and backed up with clay and river slime from the dredges, working in the trench farther out in the river. Concrete is also chuted down between the tubes and continued up over them for five feet, thus encompassing them in a solid monolithic mass. The trench is then filled around the tunnel, and the top is covered with riprap.

The construction of the approach tunnels is proceeding on lines well established by the best engineering practice; and this part of the undertaking is a huge task of itself. Two shafts were first sunk at the river banks, one on each side, and from these excavating for the center wall was carried on inland as far as other shafts, and from them to the portals. Concrete gangs followed, building up the center wall, and when this was completed, the bores were pushed forward by a modification of the shield methods of the New York tunnel work, the change being necessary because of the tough clay of the under stratum. The shafts near the river will be permanent, and they are lined with double walls of concrete. They will serve to ventilate the tunnel, and as trains move in each tube only in one direction, a constant circulation of air will be maintained.

Electricity will be the motive power used in hauling trains through the tunnel, and current from the power plant of a local concern has been arranged for. Only a small transforming station will be needed to convert the alternating current, commercially supplied, to direct current for the locomotive motors. For the operation of the tunnel eight powerful electric locomotives are being constructed. It will be brilliantly lighted with electric lamps, and the walls will be clean and bright, for there will be none of the gas and soot that fill tunnels operated by steam locomotives A system of block signals will be installed, and so arranged that no train or locomotive will enter either tube until the train ahead of it has passed beyond the summit on the other side.

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Correspondence.

Panama Canal Locks in War.

To the Editor of the SCIENTIFIC AMERICAN:

One of the strongest arguments made for the United States undertaking the construction of the Panama Canal is that it will be invaluable to us in case of war with a foreign nation, in that it will enable our warships to pass quickly from one ocean to the other. But for this very reason, the first attempt on the part of any nation going to war with us will probably be to close the canal and thus divide our naval forces. Japan could easily whip us could she attack our Atlantic and Pacific fleets one at a time and prevent them from uniting; and so could Germany or France or Great Britain. And how easy it would be to do this if all that one of these powers had to do, in order to put the canal out of commission for months, were to hire the captain of some old tramp steamer to smash through one of the gates at the locks, drop a few sticks of dynamite overboard, or scuttle the ship at some narrow point. No amount of neutralizing of the canal and international treaties could prevent a little "accident" like this; and it could be far more easily planned and executed than was the little "accident" to the "Maine" in Havana harbor; and the results would probably be far more disastrous to us. In this case, as in the other, it would probably be our first intimation that war was seriously contemplated by the enemy.

Such a state of affairs should not only be made unlikely, but it should be made absolutely impossible. There should be a sufficient number of gates and locks, and they should be so arranged with reference to each other, that the crippling of one could by no means destroy the others or cripple the canal as a whole. Wrecking apparatus should be provided, too, so that the sinking of a ship could not block the canal for more than a day or two at the most. These precautions, small though they may seem, may mean the difference, some day, between a glorious victory, on the one hand, and, on the other, defeat, the destruction of our navy, the loss of our insular possessions and a heavy tribute. CHARLES S. ADAMS.

Warren, Ohio.

Aeronautical Notes.

The latest record for duration of flight by an airship is that made by the German military airship of Major Gross, the "Bazenach," which on October 28 last was in the air 8 hours and 10 minutes, during which time it made the trip from Berlin to Brandenburg and return, a distance of 120 kilometers (75 miles). This flight, while of the longest duration, is not the longest as far as distance is concerned, as previously, on September 30, the Zeppelin airship made a flight estimated at 340 kilometers (211¼ miles) in length, during the 7 hours which it was in the air. The best previous record for duration of flight is that of the French dirigible the "Lebaudy," which, on July 6, 1905, was in the air for 3 hours and 21 minutes, during which time it covered a distance of 93 kilometers (57¾ miles). On November 23, a week before it was lost, the French dirigible "La Patrie" made a flight of 146½ miles from Paris to Verdun in 7 hours and 5 minutes at an average speed of about 21 miles an hour. The weather conditions were not good, and wind, rain, and fog were encountered. The officers in charge of the airship expected to descend at Chalons to obtain fresh supplies of gas and fuel; but this was found unnecessary, and the trip was made without a stop. Only 55 pounds of ballast was used, while the fuel consumption was but 37 gallons of gasoline, or less than half the quantity carried.

Count Zeppelin has started the construction of a new airship which he is building for the German government. The dimensions of this new airship are given as follows: Length, 130 meters (426½ feet); diameter, 12 meters (39 1/3 feet); horse-power, 240, consisting of two Daimler motors of 120 horse-power each, which will be used instead of the two 85-horse-power motors with which the present airship is equipped. The new airship is being constructed in a shed mounted on floats at Manzell on Lake Constance. It is the fourth airship that Count Zeppelin has built.

An interesting line of aeronautical experiments were conducted recently by Mr. G. Coleman Brown, of Dallas, Texas, at the "balloon farm" of Carl E. Myers, Frankfort, N. Y., which is an aeronautical experiment station. Here was successfully tested a new aeroplane principle for attaining mechanical flight. This is a heavier-than-air machine based on the aeroplane system. Hydrogen gas is used in connection, but for an entirely new purpose, for which gas was never before employed. The tests were successful in establishing the principle sought, and practical application will later be made.

The British War Department has under construction a second dirigible balloon, which will have a total capacity of 64,000 cubic feet and a diameter of 42 feet. The lifting capacity, which is 1,400 pounds more than that of the "Nulli Secundus," will give it a lifting power of 4,800 pounds. In calm weather it is expected that a speed of 40 miles an hour will be obtained, as the airship will be fitted with a 100-horse-power engine. It is expected to carry six passengers, instead of three, in this new air craft.

Aeronautics in Europe.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Somewhat of a sensation was caused at the recent banquet of the Aero Club of the United Kingdom at the Savoy Hotel, London, by the announcement that Senator Henri Deutsch, vice-president of the French Aero Club, had the intention of trying to sail from France to England. M. Deutsch, who was present on this occasion, made a speech in which he dwelt upon the advantages of aerial navigation, not indeed for war, as some wished, but, on the contrary, for advancing civilization. After this, President Richard Wallace of the British Aero Club announced officially that he had obtained from Senator Deutsch the promise to make a flight from France to England on board his airship "Ville de Paris." Mr. Wallace stated subsequently that the trial would take place as soon as a good shed could be secured for the airship, and that he would see whether the military balloon shed of Aldershot could be used for the purpose. He added that the arrival of a French airship in England would be an event of great international importance. Senator Deutsch stated to our Paris correspondent that he would attempt the voyage as soon as the question of garage for the airship was solved. He would choose the most favorable weather for making the start. After crossing the channel, he hoped to arrive at Aldershot, after sailing over London.

The promoters of the aeronautic exposition of Turin wish to give special importance to the show, and to this end they propose to establish two international Grands Prix for aerial navigation. The first prize of $50,000 will be awarded for airships, and the second prize of $20,000 for heavier-than-air apparatus. It appears that the organizers stipulate that the winning apparatus is to be turned over to the Italian government after being placed on exhibition at the show. After hearing of the project King Victor Emmanuel wished to show the great interest which he is taking in the question, both as to the progress of science and the application to military affairs, and accordingly he decided to award a royal cup, which will be competed for during the next international airship contests. On the other hand, it is stated that Lord Northcliff has just established a prize in the name of the London Daily Mail of $500 for an aeroplane which will cover a flight of half a mile, or a quarter of a mile each way, remarking that M. Farman could now easily win this prize. The interest is increasing in Great Britain, and we hear that Mr. Patrick Alexander recently made a wager with Mr. Griffith Brewer of $2,500 that he will accomplish a flight during the year following November 5 of one mile in a closed circuit.

In Russia the subject of aeroplanes has been occupying different inventors, and one of the first of these to make its appearance in the field is the new military aeroplane which has been designed according to the system of Capt. Schabsky. It is expected that a speed of 12 meters (40 feet) per second will be reached with this apparatus.

Aeroplanes are very active at Paris. Santos Dumont is continuing his experiments at the Bagatelle grounds and is making short flights with his new machine. He has already succeeded in winning the 150-meter Aero Club prize, and he soon expects to make a longer flight. It took him some time to get his machine in good condition, owing to its novelty, but he is now contented with the results. He modified it since our last account by replacing the single high-speed propeller with two propellers of larger diameter, which are mounted side by side upon the flyer and run at a reduced speed.

Henri Farman has been profiting by the enforced interval of rest due to the rainy weather by overhauling his aeroplane and putting it in good shape after its recent hard flights. Since then he has been making several good flights on the Issy grounds, and he soon expects to make another official trial for the Deutsch-Archdeacon prize. He is to modify his arrangement of the carbureter again before doing so; it is now placed higher up, and this he found to be much better for giving a good gasoline feed. The Antoinette motor has been now fitted with a magneto and it will operate a new propeller. M. Farman also found that he could lighten the apparatus at least 40 pounds, which is an advantage, and he will now be in better shape than ever.

As to M. Bleriot's new aeroplane, he is now trying it at the Issy grounds. Not long since he made the first test by rolling on the ground with his 50-horse-power Antoinette motor, and found that the framework was in good shape. This he reinforced, as before he saw that it was not strong enough. After this he made a long flight at a very high speed, and this he estimated to be not less than 50 miles an hour. His motor and propellers allow him to travel at a comfortable speed. Coming down to the ground, he somewhat damaged his carrying wheel, but this was not very serious and can easily be set right. With such a speed he will have what is needed for going around curves. However, he requires more practice with it in order to be able to operate it successfully. On the same grounds, M. Bischoff is carrying out his tests of his aeroplane. He uses an improved wood propeller made by the constructor Chauvière. During the recent attempts, he traveled over the ground, but unfortunately ran into a tree at the side of the grounds and somewhat injured his machine, which ran head down, and the rear became entangled in the branches of the tree. He will soon have the machine repaired, however. The Zens brothers are building a new aeroplane at Paris, and these inventors, who are well known in aeronautic circles, will soon have their apparatus finished for trial. It has two superposed plane surfaces with a rudder placed in front, and is fitted with a 50-horse-power Antoinette motor. M. Vuia, who made an aeroplane some time ago, and seems to be the first who adopted the method of using a rolling carriage so as to rise up from the ground, has been at work for some time upon his aeroplane, and has modified it considerably. Abandoning his carbonic acid motor, he uses an 8-cylinder gasoline motor giving 25 horse-power, and expects to begin the flights with it in the near future. As to M. Esnault-Pelterie, he has discontinued his experiments near Paris in order to build a new aeroplane which will be modified according to the results of his previous work. He may construct several different types of apparatus, fitted with 30 and 60 horse-power motors.

The Current Supplement.

The increased weights of railroad locomotives and cars has created a demand for heavier cranes for breakdown purposes. The English correspondent of the SCIENTIFIC AMERICAN describes a British articulated breakdown crane which meets this new demand. "Panama a Half Century Ago" is the title of an article based upon an old diary which was kept by a forty-niner. As one of the most important factors in the construction of a steam vessel is the riveting—and especially so in vessels of such dimensions and power as the "Mauretania" and her sister vessel "Lusitania"—it was decided to resort to hydraulic riveting to a much larger extent than usual in their construction. A most excellent article by E. W. de Rusett describes the hydraulic riveting machines which were used, and the character of the four million rivets that hold the plates together. The problem of how to protect structures from dampness is one whose solution was attempted even in the remote ages of antiquity. In an article entitled "Scientific Waterproofing" modern methods are described. The seventh installment of Prof. Watson's "Elements of Electrical Engineering" is published. The subject discussed is "Principles of Direct-Current Motors." For certain branches of suburban railroad traffic the Prussian State Railroad Department has introduced an accumulator-propelled passenger car. This new vehicle is thoroughly described in an illustrated article. The denatured alcohol situation is summarized. A new method of reducing atmospheric nitrogen is described. Cornelia Kennedy writes on "Wheat through Mill to Market." The Paris correspondent of the SCIENTIFIC AMERICAN presents an interesting account of some automobile novelties which were exhibited at the recent Automobile Shows in Paris.

To Our Subscribers.

We are at the close of another year—the sixty-second of the SCIENTIFIC AMERICAN's life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year. To those who are not familiar with the SUPPLEMENT, a word may not be out of place. The SUPPLEMENT contains articles too long for insertion in the SCIENTIFIC AMERICAN, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the SCIENTIFIC AMERICAN and SUPPLEMENT the subscriber receives the benefit of a reduction in the subscription price.

In a review of the metal trade, the Torg. Prom. Gazeta observes that the importation of aluminium into Russia fell to 7,000 poods in the first half of this year, against 24,000 poods in the corresponding period of 1906. The tendency on the part of platinum, according to advices from the Urals, says the same authority, is distinctly downward. The exportation of this metal, according to customs returns, has fallen from the level of 156 poods in 1906—the first six months—to 90 poods in the first six months of this year (1 pood=36.07 lbs.).

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RECENT ARCHÆOLOGICAL DISCOVERIES IN EGYPT.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The past season of the British School of Archæology in Egypt, the work of which has been carried out under the direction of Prof. Flinders Petrie, has been of unusual value. It resulted not only in bringing to light more evidences of the earliest eras of Egyptian civilization, but it also demonstrated the prevalence of this civilization over a wide tract of country. Hitherto the early kings have only been traced at Abydos in Upper Egypt, but now their works have been found near Cairo. These latest excavations and researches establish conclusively the uniformity of this civilization of Egypt over the country early in the first dynasty—5400 B. C. During a period of several thousand years a common government, ideas, habits, and standard of art prevailed. The details of working in stone, of the forms of pottery, and of the chipping of flints are identical in the same reign at points 300 miles apart.

The country excavated during the past year lies rather more than a mile south of the pyramids of Gizeh, opposite Cairo. Here a series of fifty-two graves for the American College there, other discoveries were made. At this point a large cemetery was excavated which had been buried by gravel washed down from the hills. But the very material which had obliterated the burial ground had served to preserve its most interesting possession from an archæological point of view. This was a unique series of "soul houses"; little models of residences which were placed upon the grave for the accommodation of the liberated soul. These are the actual dwellings in which the soul was believed to reside, and they are modeled for all classes, from the wealthiest to the poorest. Not only do they afford us an interesting insight into Egyptian religous beliefs and practices, but also in their various forms show the types of dwellings favored in the days about 3500 B. C.

The simplest type of "soul house" is a crude affair, comprising in fact a single room with one or two openings with a slight shelter propped up on poles like a Bedawy tent. Curiously enough, the typical residence of the lower classes of society has scarcely altered during the passage of the centuries, for it bears a very striking resemblance to the peasant's to the ground floor, where there was plenty of weight on the spring, but a high-arched parabolic skew roof to the upper floor, and a small arch over the front gallery. In some cases hood moldings were placed over some windows, showing that the residences from which the miniatures were copied were situated in a wet climate.

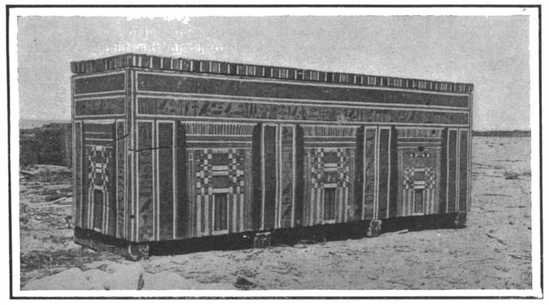
The ventilation of some of these soul houses was of an elaborate character. Commissariat for the dead person was not neglected. In some of the houses the roofs carried corn bins. There were also for the soul's sustenance ribs, bulls' heads, haunches, and so forth, together with adequate supplies of water. Apparently each house was designed for one soul.

Another discovery was a very fine group of coffins, etc., in an untouched tomb dating back to approximately 3300 B. C. The outer shells are elaborately painted and at first sight, owing to the skill with which the work is carried out, resemble inlay or mosaic work. The coffins themselves were of huge dimensions, of rectangular form, and upon being opened revealed fine examples of mummy cases, covered with intricate and delicate colored patterns of the deck and finely painted with eyes of Horus, lotus flowers, and rosettes. One feature of these models is the striking definition with which the members of the crew are reproduced in the carving.

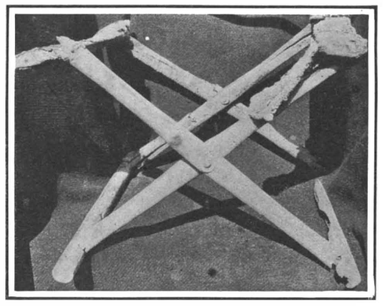
Some excellent specimens of the weapons of the period wrought in copper were also found. The finest example is a dagger fitted with a handsome ebony and silver handle; it has since been placed on view in the Fine Art Museum at Boston, Mass. A seated figure executed in granite, and which is very rare in this period, is now preserved in the Metropolitan Museum, New York, and other objects, all excellent specimens of their character, have been acquired by various other museums.

Coming down to a more recent period—about 1500 B. C.—a large quantity of quaint figures or statuettes worked in rough pottery and limestone were found, together with some furniture, the most interesting specimens of which are a folding stool, and the lid of a basket in a splendid state of preservation and of fine workmanship.

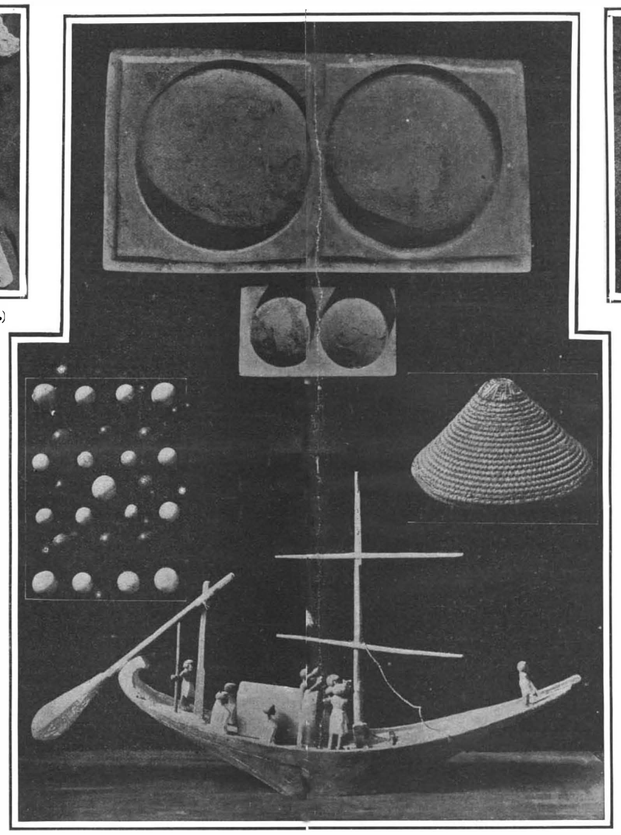
Valuable discoveries were also made in a Coptic monastery of the seventh century. Here a set of



A Decorated Coffin, About 3300 B. C.

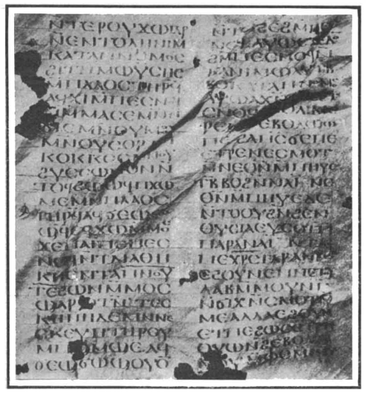


The Predecessor of the Camp Chair (1500 B. C.)

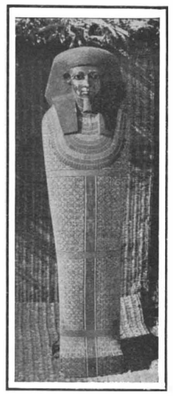


Marbles of 6500 Years Ago. An Artist's Palettes. A Basket Lid. A Boat Sailing Up the Nile.

Pottery of the First Dynasty from Gizeh.

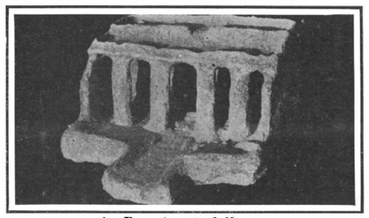


A Bible Fragment of the Seventh Century.

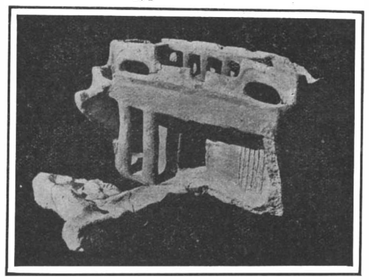


Decorated Mummy Case.

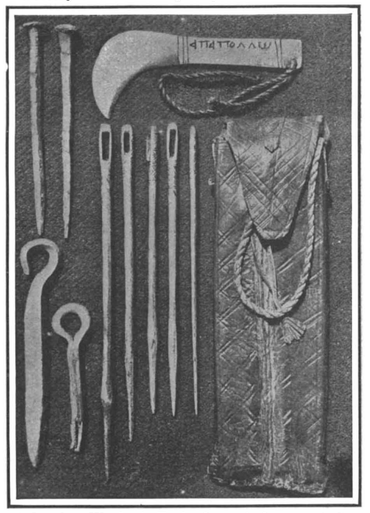
Graves of the First Dynasty at Gizeh.



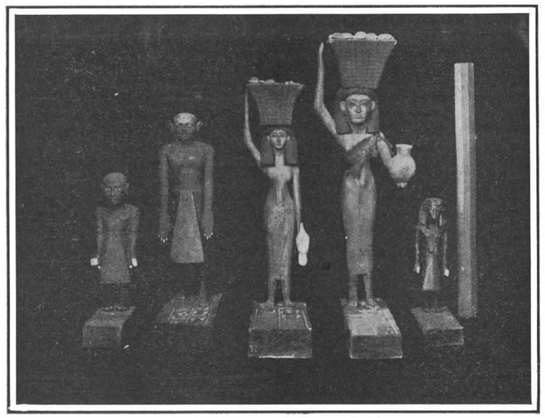
An Egyptian Soul House.



A Soul House with Veranda on Upper Story.



A Leather Worker's Tools, Seventh Century A. D.



Statuettes from Coffins at Rifeh.

were found surrounding a royal tomb. They extended in longitudinal rows each separated from its neighbor by a thin earthen partition or wall. One-half of these vaults contained relics such as pottery placed in a basket, slate palettes containing red and black paint as used by the painters and scribes, glazed pottery ornaments and vases, ivory carvings, and delicate needles of gold provided with minute eyes. The age of these relics is definitely determined by a clay seal which was unearthed and which bears the name of King Zet, the third monarch of the first dynasty. In another great sepulcher seals of the second dynasty were found, while a third great sepulcher, of the third dynasty, yielded about sixty-five small stone marbles fashioned out of milky quartz, brown quartz, and cornelian, and which were used in some early Egyptian game. This discovery goes to show that the use of marbles for a pastime is of extremely ancient origin. These discoveries through the first three dynasties throw light upon early civilization at Gizeh during the 800 years before the erection of the colossal pyramids in 4700 B. C.

At Rifeh, near Asyut in Upper Egypt, so well known home of to-day. Some of the houses were more elaborate. Usually a portico or veranda with raised edges ran around the roof, with generally a small chamber behind it, which was gained by means of a stairway. In other cases a hut was placed beneath the portico while a back chamber was also provided, fitted with a doorway. The closed room performed the office of storeroom and was shut with a mat of maize stalks.

The more elaborate soul houses had wind openings similar to those of modern Egyptian residences, and an upper veranda on the roof. In some instances the houses were more imposing, possessing two stories, while others had three divisions on the roofs and several types of closed doors, while in one instance there were serrated walls such as are adopted in the more modern buildings upon the site of this ancient cemetery. In addition to the mere residences, miniature articles of furniture are shown. There is the couch with a headrest, the stool, and a woman making bread under the sloping stairway. The constructive details are of great interest, there being flying brick stairways curved in a quadrant, which show much ability in arching. A side of a house shows a flat-arched roof most exquisite workmanship. Many relics were found, including statuettes ranging from six to eleven inches in height representing the dead persons and their retinue of servants, the latter bearing on their heads and in their arms baskets and vases of offerings. Possibly the quaintest and most interesting finds were two small models of river boats of the period, of beautiful workmanship, and in excellent preservation. In one instance the craft is being rowed down the Nile, the mast being stowed, and the sail packed up, with five of the crew seated on either side at their oars. In the other case the mast is stepped, the boat being before the wind, and the crew are shown in the act of hauling up the yards, the oars being discarded. In the bow is the look-out, while at the stern is the helmsman, both being closely wrapped up to protect them from the bitterness of the north wind, while the members of the crew have donned a kilt in accordance with the usual procedure when the boat was sailing with the wind. On the deck of each boat is a cabin in front of which sits the captain. Both the boats and their equipment are intact, the steering oars mounted on a rudder post extending upward from the leather workers' needles and knife was found packed in a small leather case or pouch for convenience of transport, together with many stone inscriptions and a great quantity of leaves of manuscripts, one of which, here shown, contains the ninth chapter of the Book of Hebrews. Upon this same site many other fragments of the Bible, apocryphal books, lives of saints, and business transactions were also brought to light.

During the coming winter the British School of Archæology in Egypt will commence the clearing and investigation of the ruins of Memphis, from which many valuable and important results bearing more particularly upon the commerce of the early Egyptians are anticipated. The work will be carried out under the direction of Prof. Flinders Petrie, to whom we are indebted for the information and photographs accompanying this article, assisted by six students. Memphis was the great capital and commercial center of the life of Egypt throughout a period of 6,000 years. Thanks to the substantial support which has been accorded to this undertaking from this country, principally through the efforts of Dr. Winslow of Boston, a great number of valuable objects of ancient Egyptian civilization, handicraft, and commerce are assured every year for the enrichment of the various American museums.

The Sense of Vision in Vertebrates and Cephalopods.

In order to form an idea of the sense of vision in vertebrates and cephalopods, the refraction and accommodation should be considered. The human eye, like a photographic camera, is always adjusted only for a given distance, and the normal human eye in a state of rest for an infinite distance. Those objects which are situated close to the eye cannot be reproduced by a well-defined image in the retina unless the eye be adjusted for or accommodated to a smaller distance. This is performed by the function of a system of angular muscles situated in the eye socket, and which is able to alter the convexity and accordingly the refraction of the eye.

Some interesting facts about the question of sight accommodation for varying distances in the case of higher and lower animals were given by Prof. Heine at the last Congress of German Naturalists and Physicians. It was pointed out that in all mammalia and birds, as well as in many amphibia, mechanism of accommodation similar to that of the human eye is found with more or less perfection, being specially developed in apes. The bigger the animal and its eye, the less this power of accommodation seems to be developed. In the case of birds a considerable improvement is obtained by the transversely striped muscular system as compared with the smooth muscular system of mammalia. The focus may thus be altered with remarkable rapidity, which is especially important in the case of birds catching their prey while flying. In many reptiles another mechanism of accommodation is found, the lens being displaced instead of being deformed, being protruded or withdrawn. This allows of a very ample accommodation, and in certain species a combination of both mechanisms is found. The eye of fishes is adjusted most actively to a distance by the (rigid) lens being drawn backward.

It is interesting to note that in the case of inferior animals such as cephalopods (polyps, sepia, etc.) the most complicated eye mechanism should be found, the eyes of these animals being adjusted from a central position to greater or smaller distance by a forward or backward displacement of a rigid lens under the action of an internal muscular system. While these mollusks are otherwise far below even the lowest vertebrates, their mechanism of adjustment seems to be comparable to that of some highly developed birds, and by no means to the far more elementary accommodation mechanism of man. In fact, comparative physiology shows man to be inferior from the point of view of his senses to many animals, being excelled by dogs as regards his sense of smell, by most animals as to his sense of hearing and even by the lowest mollusks as to his power of vision.

Venus as a Luminous Ring.

Venus has on many occasions been observed when its phase corresponded to that of the new moon, but recently the excessively rare phenomenon of Venus as a luminous ring was noted by Messrs. Russell and Daniel of Princeton Observatory, using a 5-inch finder. The observation was made on the 29th of November, 1907, at 5h. 7m. (G.M.T.), when Venus was 1 deg. 49 min. away from the center of the sun. At this time the planet was theoretically invisible. However, during moments of atmospheric tranquillity, the planet detached itself clearly on the black of the sky, and showed itself surrounded by a luminous ring, the interior of which seemed darker than the surrounding space. It is believed, however, that this characteristic is a subjective effect. The ring phase may be observed again in 1914, after which it will be necessary to wait until 1972 before a favorable opportunity of studying it will again be provided.

The British Admiralty have created a new post of Inspector of Diving. At present the inspector will have his headquarters on the "Excellent," and will have sole charge of the instructional duties and of all questions that may arise in regard to diving, under the general directions of the captain of the "Excellent." The intention is that the officer holding this appointment, while still borne for gunnery duties, shall be looked upon as the diving expert in the navy, to whom all questions may be referred through the usual official channels.

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A CHROMATIC ILLUSION.

BY GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

A quality of the nervous element of the eye, that of inverting all images painted on the retina, was the cause of the inversion illusion described in the May 25 issue of the SCIENTIFIC AMERICAN; the cause of the illusion described here is, on the contrary, a serious though ever-present defect of the normal eye.

With a single stroke of your penknife make a slit nearly one inch long in the middle of a large piece of dark-shaded pasteboard. Over half the length of the slit lay a piece of blue glass, and keep it in place with some gummed paper stuck on the edges of the glass, so as to let light pass freely from the slit through the glass. Over the other half of the slit fix in a similar manner a piece of red glass. This being done, the card, seen on the opposite side, will look as shown on the following figure, *B* and *R* being the blue and red halves of the slit.

Take another piece of the same pasteboard, and near a corner make two pinholes one-eighth of an inch apart. The apparatus is now complete and ready for use.

Place yourself near a source of light, lamp or window. Bring the card bearing the two pinholes in contact with one eye, the two holes lying on a horizontal line, and, through them, look at the vertical blue and red slit, *B R*, on the other card, this being placed at a distance of about one foot from the eye and right in the middle of the field of vision.

The following figure shows the appearance of the card thus observed. Two luminous red slits and only one blue are perceived.

The card bearing the slit may be inverted. The result is the same; the red goes up, the blue goes down, the red slit is duplicated, the blue is not. As everything but the color is symmetrical, right and left, up and down, on both cards, any observer will promptly reach the conclusion that the cause of the illusion lies, not in the position, size, or shape of the slits or pinholes, but in the difference in color of the slits.

The inference is right. Owing to its defective achromatism, the eye does not bring red and blue rays to one and the same focus, and the little apparatus shows that this aberration is far from being an insignificant factor of the imperfection of normal sight. The following two figures show the path of the luminous pencils emitted by the blue and red slits and admitted by the two pinholes. (Distance from slit to eye has been shortened to spare space, and the refraction phenomena in the several humors has been simplified.) The blue rays emitted by the slit *B* are brought to a focus, *b*, on the retina, but the red rays are less bent than the blue; and although the distance of both blue and red slits from the eye is the same, the red pencils emitted by the slit *R*, and admitted by the two pinholes, strike the retina in *r r*, before meeting, and give thereby the impression of a double red slit.

If the card bearing the slit is placed at much less than one foot from the eye, two blue slits, much closer together than the red ones, will be perceived. The blue pencils, in that case, also meet behind the retina, although not so far behind it as the red pencils under the same circumstances. The card with the slit must be large, to prevent side light from partially closing the pupil, thus increasing notably the achromatism of the eye. For a similar reason, if the two pinholes are much less than one-eighth of an inch apart, the experiment is much less remarkable; the central instead of the marginal parts of the crystalline lens are made to work, and increased achromatism is the result.

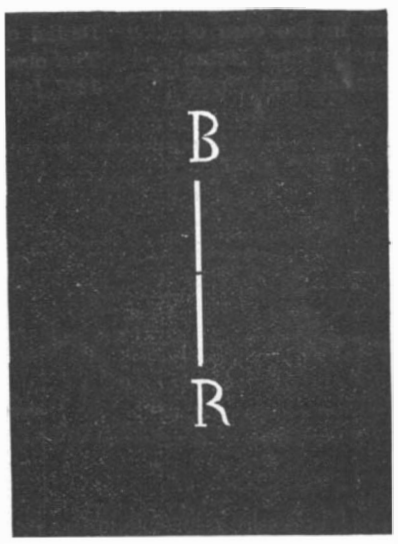

Fig. 1.—The Slit as It Is.

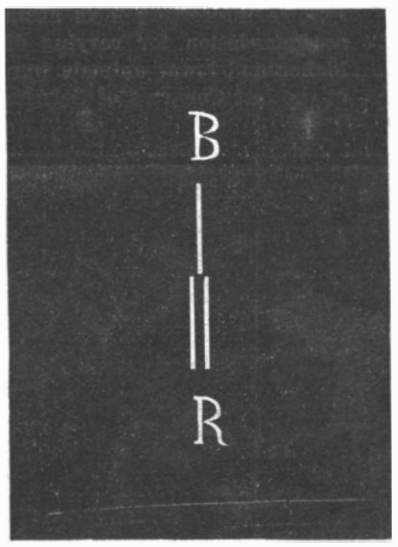

Fig. 2.—The Slit as It Appears to Be.

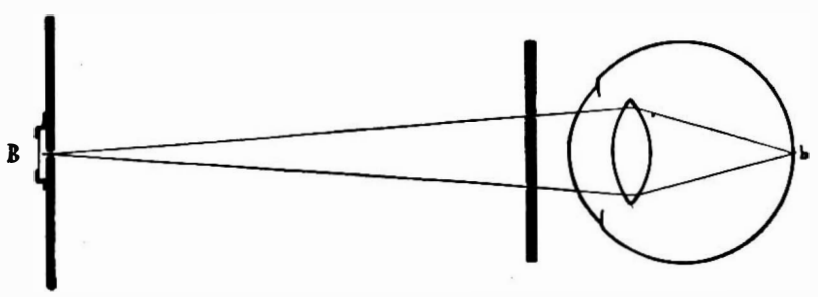

Fig. 3.—Path of the Luminous Blue Pencils.

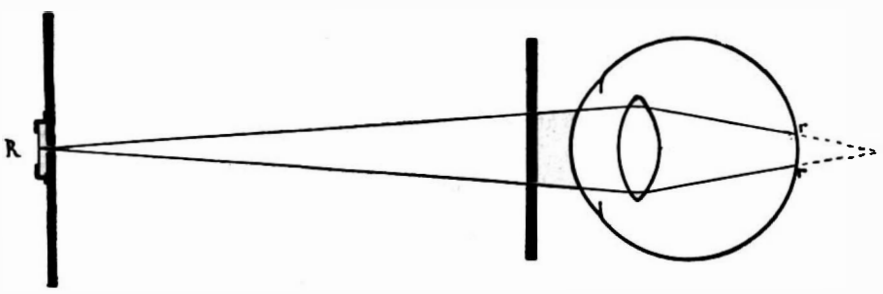

Fig. 4.—Path of the Luminous Red Pencils.

No Fire Peril in Pennsylvania Terminal.

Contracts have been closed for the construction of floors, interior partitions, and roof of the Pennsylvania's new Manhattan Passenger Terminal. Protection of the 400,000 passengers who will pass in and out of this station daily has absorbed the attention of the company's engineers a long time, and to avoid the possibility of fire they have selected a material, every block of which is tested by being heated red hot before being used, to be sure that it is unburnable. Porous terra cotta was the only building material which was found able to withstand such a test, and the railroad's engineers have decided to use it in the form of hollow blocks as a covering for the gigantic steel frame of the building, and for the partitions and roof, as well as for lining the outside walls.

If all the blocks used in this work should be built into a wall ten feet high, it would stretch from the station to Newark, N. J., a distance of twelve miles.

The "Mauretania" Beats the Record.

In spite of a fresh gale and a high following sea during her last passage, the "Mauretania" beat the best eastward time of her sister ship, the "Lusitania," by 21 min., completing the run from Sandy Hook to Daunt's lightship in 4 days, 22 hours, and 29 minutes. The average speed was 23.69 knots, and the best day's runs were 556 knots and 554 knots respectively.

The Lady of Senbtes.

During the excavations made under the direction of the Metropolitan Museum of Art in Egypt, a mummy now known as the "Lady of Senbtes" was discovered. It is believed that it is the oldest mummy that has been discovered so far. When the tomb was opened, Dr. Eliot-Smith, professor of anatomy at the Cairo School of Medicine, was called in, and made an interesting report. He found that the lady was of the twelfth dynasty, about 4,000 years ago. She was fifty years old at the time of her death and was slender, with a small, almost infantile face. Her eyes were large and round, and her nose well proportioned, being neither aquiline nor flat. Her teeth were remarkably well preserved. The mummy was that of a person of very high caste, as was shown by the ornaments buried with it. On the breast was a dagger in a gold-capped sheath of wood, and in the hair was a weave of gold filigree work profusely decorated with gold rosettes. Perhaps the most interesting find in this connection was the discovery of the ceremonial whip of Senbtes, which was lying beside the mummy in the coffin. This whip, the only perfect one in existence, was swung ceremonially by those high in authority.

A CHROMATIC ILLUSION.

Arbitration proceedings between the Ottoman government and the Ottoman Railway Company have been commenced before Señor Maret, the ex-premier of Spain, who has been nominated umpire by the Kaiser, the former arbitrator. The chief matters in dispute, says Reuter, relate to the harbor works at Salonika, the port of Dedeagatch, and questions of customs and maritime transports. The sum involved amounts to about $16,000,000.

NEW AND INGENIOUS FRENCH TOYS.

Many ingenious devices, some of them of practical utility, were to be seen at the seventh annual toy show at the Tuileries, Paris.

Diabolo, the ancient game that has again become popular, was represented by numerous models, ranging in price from two cents to more than two dollars, according to size or material, the latter including wood, metal, celluloid, cork, rubber, and cloth.

Diabolo has inspired several similar toys; among which is the "climbing shell." The apparatus consists of a deeply grooved flat spool or disk, a cord, and a fork with two bent tines. A metal pin projects from each side of the disk to hold it on the fork, One end of the cord is attached to the disk, the other held in the hand with the fork, and the cord is wound up in the groove. The pins are rested on the fork, when the latter is tilted to let the disk roll off. As it falls it rapidly unwinds, and as it reaches the end of the cord keeps on spinning, and so rewinds itself up the cord. Just as the disk is at the lowest point a quick upward pull is given to the cord. This pull must be just sufficient to replace the energy lost by the disk, and so enable it to climb as high as the point it fell from. The trick consists in giving the right amount of jerk at the right moment, and to present the fork in such a way that the disk is caught at the top of its flight.

Similar in principle to the foregoing is the Rail Ball. A rubber ball is placed on two parallel curved rails, one extremity of which is held in the hand, and the ball is caused to roll up the rails and lodge securely in the ring which terminates them, by means of a dexterous movement of the wrist. The rails and the ring are made of one piece of iron wire.

The Joust is another game of skill. A little tub filled with water or flour swings from a cross-beam supported by two posts. One end of a railway is inserted between the heavy bases of the posts and the other end is supported on blocks at any desired height. In a carriage stands a puppet armed with a lance. It is required to adjust the direction and the inclination of the railway so that, when the carriage rolls down the grade, the lance shall enter a hole in a vertical plate attached to the bottom of the tub. Otherwise the lance will strike the plate and overturn the tub, spilling its contents on the lancer. The difficulty is increased by giving an oscillating motion to the lance. Similar jousts, entailing the same risk of being drenched with water or covered with flour, are practised by human lancers at French country fairs. The Weathercock Race is a modification of the popular French game of "*Petits cheveux*." The innovation consists in causing the circle of horses and riders to revolve, alternately in opposite direction, as it glides down a pole. This result is accomplished by means of two spiral grooves, corresponding to right and left handed screws of long pitch, which are cut on the inside of the sleeve or hub of the circle of riders, and which encounter and engage with pegs on the post as the circle descends. The horse which stops nearest a marked goal is the winner.

Another game of chance is Toboggan Marbles or Toboggan Billiards. An inclined board is crossed obliquely by a number of wires. A small interval is left between the lower end of each wire and the upper side of the next one, so that a small ball, placed on the upper wire, will roll down along all the wires in succession, following a zigzag course, to the bottom of the board, and there fall into a numbered compartment. An interesting feature is the automatic and successive release of the twelve balls, which is accomplished as follows: A rod, mounted so that it can turn freely on its axis, runs along one inclined side of the board. The ends of this rod are bent in such a manner that, during the descent of the first ball, the second and succeeding balls are stopped by the upper bent end, but when the moving ball reaches the bottom of its course it lifts the lower bent end of the rod, thus releasing the second ball by turning the rod, which immediately falls back into its original position and holds the third and succeeding balls. Along the other inclined side of the board an endless band is stretched over two rollers. By turning a crank attached to the upper roller a sort of spoon carried by the band is made to pick up the balls from the receptacle at the base and carry them, one by one, to the top wire, for another descent.

The Balloon Accident is a lottery in which the winner is determined by the fall of the aeronaut. A card

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is divided into sectors marked with the names of different countries. From the center rises a mast which bears a yard at its top. An imitation balloon, with its basket and aeronaut, is hoisted by a cord which runs up the mast and over a pulley on the yard. But the pulling of the cord also causes the mast to rotate so that the balloon passes over the different countries. The contact of the top of the balloon with the yard releases one of the attachments of the basket which overturns and drops the aeronaut. The players guess the country in which he will land.

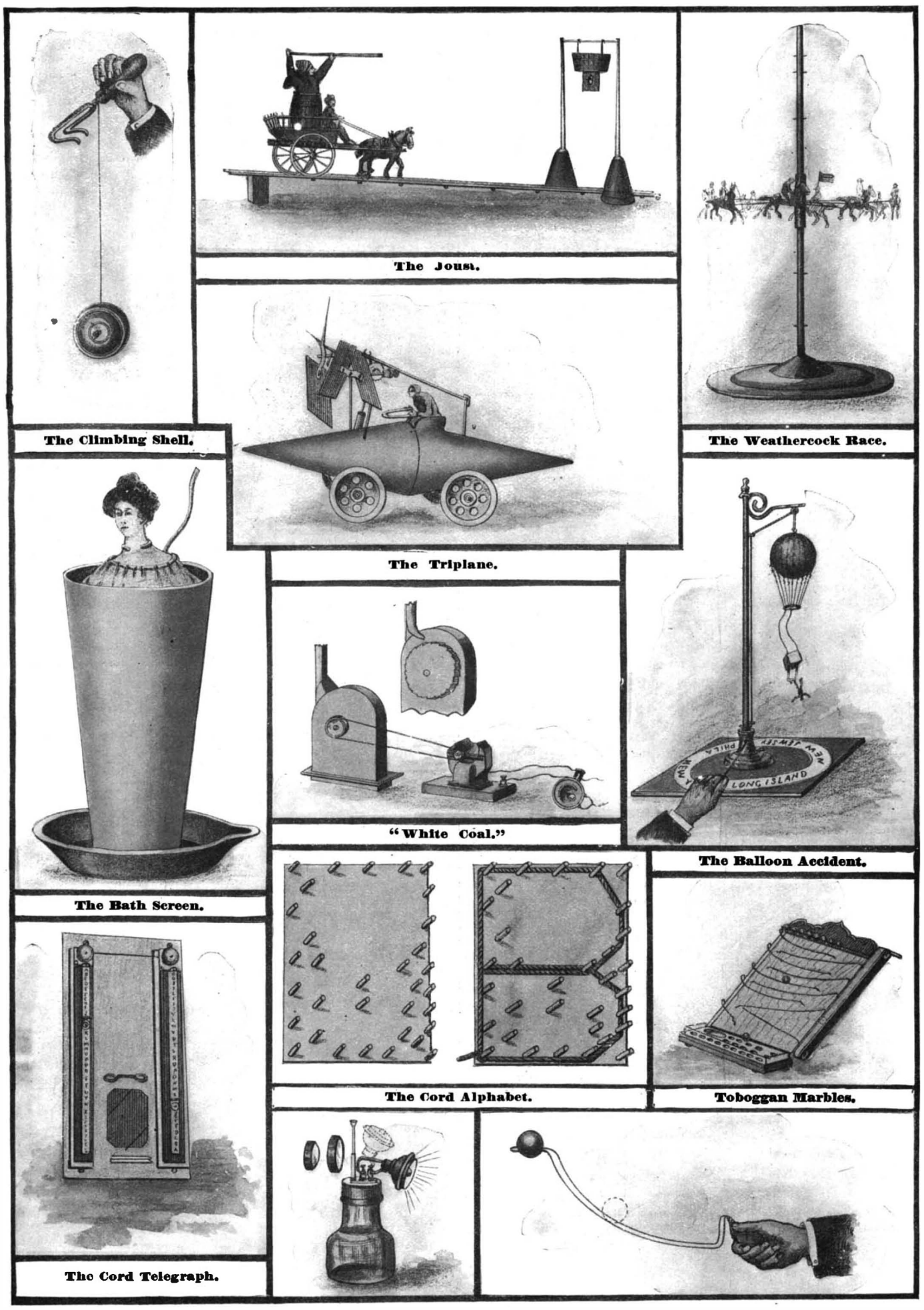
The Triplane is a vehicle that can travel on land, on water, and through the air. It has a hull in the form of a double cone, and four wheels for traveling on land. It is propelled by a large air propeller, driven by clockwork, and develops a fair speed both on land and on water. For aerial navigation the wheels are replaced by aeroplanes and the vehicle is suspended by a long cord. The Triplane is an instructive toy, because it illustrates the action of air propellers.

Another scientific toy bears the fanciful name of *Houille Blanche*, or White Coal, which French writers apply to waterfalls regarded as sources of power. A small but powerful turbine, attached to a water tap, drives a variety of machines, including a little dynamo which produces sufficient current for the operation of a tiny incandescent lamp, thus giving a striking illustration of the transformation of energy.

The Cord Telegraph comprises two grooved posts, two equal weights which slide in the grooves, and a long cord attached to the weights and passing over pulleys at the top of the posts. Each post is marked with the letters of the alphabet, but the alphabetical order runs up one post and down the other. Each weight carries a pointer. If one weight is moved so that the pointer indicates successively the letters of a word or cipher the other weight will move so as to spell out the same word on the other post. The posts may be set at any distance apart. The call is made by moving the weight rapidly to the bottom of the post, thus raising the other weight as rapidly to the top of the distant post, where it strikes a bell.

The Cord Alphabet is an instructive puzzle designed to fix the forms of letters in the minds of young children. The apparatus consists of a pattern alphabet, a cord, and a board in which about forty nails have been driven in such arrangement that any of the capital letters and numerals can be made by wrapping the cord around the proper nails. Two devices of practical utility deserve mention. The Bath Screen, or Spray Catcher, is designed to supplement the ring douche and protect the carpet, which is likely to suffer if no screen is used, even if the tub is three feet in diameter. With the screen a small foot tub suffices and a bath can be taken in the smallest room. The screen is a bottomless bag of waterproof fabric, distended by a rigid ring at the top and supported by cords attached to a smaller ring which rests on the shoulders.

The Electric Searchlight has a wide field of usefulness. The battery is of the bottle type and its only novel feature is the ease with which it can be taken apart for cleaning. This is important, as cleanliness is essential to perfect working. The zinc, which is the only part consumed, can be renewed with the greatest ease. The lamp is mounted on a joint so that it can be turned in any direction. For use in the photographer's dark room the lamp and reflector can be inclosed in a hood with a ruby window. For reading in bed, a short focus lens, mounted in a similar manner, projects a strong parallel beam. If the zinc is immersed gradually the lamp may be used several hours.—Translated for the SCIENTIFIC AMERICAN from La Nature.



NEW AND INGENIOUS FRENCH TOYS.

The Hand Grenade in Our Army.

The Ordnance Department of the army has been experimenting for some time past with a hand grenade, for use in places where the attacking party has been able to come close to the besieged, and when the fire of the small-arms rifle would be ineffective, owing to its flat trajectory. The fact that the Japanese used hand grenades with telling effect during the war with Russia, and opened a way when field guns and small arms were practically useless, and also the fact that this country is the greatest lover of base ball in the world, has induced the government to experiment with grenades. As grenades are usually thrown by hand, it is planned to organize a corps of army ball players, to throw the projectiles as one would throw an ordinary base ball, although there is under consideration a design of a small mortar for throwing these projectiles a greater distance than they could be thrown by hand, and yet be light enough to be carried by hand.

The grenades as tested by the Ordnance Department were of about one pound in weight, and could be thrown by a muscular man a distance of from 100 to 125 feet, and over obstacles from 50 to 60 feet high. This method of throwing by hand is, however, more or less uncertain, for the reason that the hand grenade is loaded with a high-power explosive, and should one of them be dropped or handled carelessly, there would follow a terrific explosion, resulting probably in great loss of life.

The mortars as used by the Japanese were of wood, about three feet long with a caliber of five to six inches. Mounted at an angle of about 55 degrees, grenades were thrown a distance of over 1,000 feet, with a charge of only two ounces of black powder.

It is the consensus of opinion of many officers of the army, that such a corps as is planned would be very effective, and the means of quickly reducing a fort which could not be scaled, or one whose location would not permit of the use of field guns. There would be a practical immediate use for grenades in the Philippines, where our troops are almost daily fighting the rebellious natives, who are intrenched in inaccessible places, where field guns could not be used, and where the hand grenade would prove the only effective means of attack.

It is stated that there are over 5,000 motor-boats on the canals of Holland, mostly driven by kerosene motors.

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RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

HAT AND COAT HANGER.—A. A. LOTT and R. C. STEIN, Birmingham, Ala. The patentees have designed a garment-holder to be formed out of wire which is provided with a main frame that may be given an ornamental shape such as the general configuration of a shield. The wire is twisted in a very ingenious manner so as to form a series of coat and hat holders from the bases of these coat and hat hangers, and shaped to connect and brace the main frame.

Of Interest to Farmers.

LOADING APPARATUS.—A. J. DERBY, Honolulu, Hawaii. More especially the invention refers to apparatus for loading sugar-cane and the like in the field for conveyance and transportation of the same to one or more places or stations, as a sugar factory for instance. A principal object is to provide an apparatus comparatively inexpensive besides being time-saving and labor-saving, and possessing capacity for long and repeated service.

Of General Interest.

SIGHT FOR FIREARMS.—E. W. EVANS, Greenwood, British Columbia, Canada. The invention relates to sights for firearms, and has for its principal object to provide sights for arms which will prevent the blurring of the vision of the marksman when he is aiming at a mark. It provides the sights with surfaces which will give such a contrast as will assist the marksman when aiming at dark objects.

FOLDING STEP-LADDER.—A. DAHL, New York, N. Y. The object of the inventor is to provide a folding step ladder, for use by painters, interior decorators, and other persons, and capable of being folded into a comparatively small package to be conveniently carried from one place to another, and also of being readily extended for its legitimate use.

HEDDLE-FRAME FOR LOOMS.—G. BRISSON, Lewiston, Maine. The invention pertains to weaving, and its object is to provide a harness, more especially designed for carrying the selvage warp, and arranged to permit convenient and quick repair of a broken heddle without requiring cutting of the selvage and without wasting the other non-injured heddles or other parts of the harness.

BOTTLE-STOPPER.—J. A. MOLLER, JR., New York, N. Y. A purpose in this case is to provide a construction of bottle stopper adapted for ready attachment to any form or type of bottle, which stopper can be quickly and conveniently cleaned and operated to open or close the bottle, and whereby the movements of the stopper for opening and closing can be accomplished by the application of the thumb only.

Hardware.

TOOL.—G. H. GOODHOLM and J. A. TRAIN, Lindsborg, Kan. In addition to splicing wire, the tool is for use in cutting pipes and rods. It is more especially directed to the cutting of porcelain and other brittle tubes such as are used for insulating purposes. There is the provision of means for the uniform cutting of tubes which may not or may be of exact cylindrical cross section, and for a novel pivotal adjustment for the operating levers.

SAFETY-RAZOR.—L. HEUSER, New York, N. Y. The invention has for its object to provide a safety attachment simple in construction, effective in operation, and durable in use, adapted to be used with razors of ordinary or special construction. The guard is readily removed from the razor blade by raising the free end of the clamping arm and releasing the offset end or hook from engagement with the back of the razor.

Heating and Lighting.

CHIMNEY-COWL.—M. LUDWIG, Albany, Ore. The present invention is an improvement upon the one for which Mr. Ludwig formerly received U. S. Letters Patent; and it relates to the construction of the top or cap proper of the cowl and to the means for supporting the same and securing it detachably yet rotatably. The spider or cowl attachment is adapted for application to two different sizes of chimney pipes.

CRUDE-OIL BURNER.—A. D. MARCOTTE, Church Point, La. This is a form of vapor generator and burner particularly adapted for the consumption of crude or heavy oil. The burner comprises a U-shape tube arranged horizontally with one leg over the other, the lower being provided with gas nipples and with a sliding cleaner, a second tube arranged over the U-shape one and a small tube connecting the second tube with the lower branch of the U-shape tube.

Household Utilities.

COMBINED BOOKCASE AND FOLDING BED.—W. FREEDMANN, New York, N. Y. The inventor has in view the provision of a bookcase having a compartment formed at the rear thereof in which is adapted to be contained when in folded relation, a bed of novel construction. The case is revolubly mounted, whereby it may be easily reversed to bring either the bed or front of the case to accessible position.

Machines and Mechanical Devices.

WELL-DRILLING MACHINE.—N. D. WELLS, Tulsa, Indian Ter. The machine is arranged to permit convenient actuating of the drill-rod at the beginning of the drilling operation by the employment of a spudding device, without the use of the walking-beam, and to allow convenient and quick lifting of debris, etc., out of the well, independent of the spudding device and beam.

CHANGE-SPEED APPARATUS.—A. SAUER, Pittsburg, Pa. This apparatus communicates rotary motion from a motor shaft to another shaft arranged for driving machinery of various descriptions. By substituting gears of one size for others of different size the speed of the driven shaft may be changed at will relative to the speed of the motor shaft. There is a special provision of means for adjusting the gears, to take up wear or compensate for imperfections or irregularities in the bearings.

RETHRESHER AND POLISHER FOR COFFEE.—E. C. PRIETO, Cipaquira, Colombia, S. America. This machine has means for subjecting the coffee grain or bean to a rubbing or polishing action, and improves the means for subjecting the same to an air current during the polishing process, for the purpose of separating out chaff or bran. Means regulate the degree of pressure to which the grain is subjected during the polishing process.

LIFTING-MACHINE.—C. MOLLER, Jacksonville, Fla. The invention in this instance is to provide a lifting machine simple and portable in construction, and more especially designed for picking up barrels and other packages from the ground or floor and elevating and discharging the same at any desired height for storing, stacking, and other purposes.

WEIGHING-MACHINE.—G. H. MALLETT, Copake, N. Y. In this patent the invention has reference to means for depositing powders or granulated commodities of various kinds in a plurality of receptacles at the same time, and is designed to provide means for accurately weighing and placing the commodities in even proportions in each of the several receptacles.

MULTOGRAM RECORD.—A. HOFFMAN, New York, N. Y. The invention relates to records used for talking machines, the more particular object being to provide a record with a multiplicity of record tracks for the purpose of increasing the amplitude and volume of the sound vibrations. Among further means it relates to those for separating the various record tracks from each other, so as to prevent a stylus from one of these record tracks moving into another.

CLUTCH.—P. DANIEL, New York, N. Y. The aim in this case is to provide certain improvements whereby the connection between the driving and the driven member is effected by means of a fluid which may freely circulate to permit one member to rotate in respect to the other, and which may be prevented from circulating to effect the simultaneous movement of the two members.

AUTOMATIC SWITCH-GOVERNOR.—L. COLSON and C. GEBAUER, New York, N. Y. The more particular object of the invention is to produce a mechanism suitable for use in connection with stereopticons and with projectors for moving pictures, and in which the lamp is automatically extinguished in case the mechanism moving the film of the projector is stopped, so that the heat from the lamp endangers the film.

WIND-MOTOR.—J. W. BEATES, Denver, Col. The purpose of this improvement is the provision of a new wind motor, arranged to utilize the motive power of the wind to the fullest advantage by varying the length of the stroke of the pump rod according to the velocity of the wind.

Prime Movers and Their Accessories.

ENGINE-STARTER.—F. L. ORR, Thurman, Iowa. The invention refers to means for starting gas or gasolene engines, and the object is to provide power means adapted for cranking internal combustion engines in general, stationary or movable, but more especially for starting engines of the general character stated, employed on gasolene automobiles.

Railways and Their Accessories.

RAILWAY-SWITCH.—J. F. REESE and C. L. MINER, Lucerne, Ind. An object of the invention is to provide a device which can be readily applied to the switch and which will not interfere with the ordinary operation of the switch by means of a switch bar or the like. An improved tripper is carried by the car for operating the switch.

Pertaining to Vehicles.

AXLE-LUBRICATOR.—A. B. DAY, Knoxville, Tenn. The improvement relates to axle lubricators in which the outer end of the hub is provided with an opening for reception of lubricant, the same being normally closed by a spring valve. The lubricating attachment contains a normally seated valve, but adapted to be opened by due pressure, the body or cage being adapted to be screwed into the wheel hub and a portion of the attachment projecting into the recess in the end of the axle.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(10642) H. R. writes: Having had a discussion with an acquaintance bearing on the working principle of a syphon, I wish an authority to settle the dispute, as neither has convinced the other to his view. I maintain that the weight of water in the "draw" lifts the water in the "lift" and that by keeping the weight of water in the "draw" greater than that in the "lift" the flow can be kept up; meaning that the "draw" end of the syphon must be longer than the "lift" end. The other party maintains that the syphon operates through atmospheric pressure. That the air being drawn from the pipe and replaced by water, the atmosphere by its pressure on the body of water to be moved forces the water through the syphon. At the end where the water flows out of the pipe he claims the atmospheric pressure has been removed. He won't see that the pressure is the same at both ends. I also maintain that water will lift or pull water, as it does in the syphon, claiming that when the pipe is filled and no air allowed to leak in, the molecules of water are held together by the equal pressures of air at both ends of the syphon, thus preventing segregation. He maintains that water cannot lift or pull water, because it is a liquid and not cohesive. The discussion arose by the intention of a coal mining company of which I am a director to syphon the water from air workings. The water will have to be lifted a vertical height of about 175 feet. A plumbing contractor here whom we consulted in regard to pipe told us we could not syphon water where the lift was more than 60 feet vertical at sea level, and at this altitude (4,500 feet) not more than 40 feet. We have already easily syphoned water over a vertical height of 60 feet, so we knew he was wrong. I would like to know also of an instance of the greatest height over which water has been syphoned, if you know one. A. A syphon operates by the pressure of the atmosphere. This fact is fully demonstrated in text books of physics. The pressure of the atmosphere is equal to that of a column of water 34 feet at sea level, so that no syphon can lift water any higher than that. Indeed 28 to 30 feet is as high as it is practicable to carry water by a syphon. Experiment has fully confirmed the theoretical deductions. It is true that the greater weight of water in the outflow pipe determines the direction of the stream, but the water is lifted into the other arm of the syphon by the pressure of air on the water in the reservoir. When this arm is longer than 34 feet the pressure of the air is not able to lift the water to the top of that arm and water cannot run over the bend of the pipe. Except for the presence of water vapor a vacuum exists in such a pipe above the water. Because of the air always present in running water a syphon will not carry water to its full theoretical height, and in many syphons it is necessary to provide an outlet for this air at the top of the pipe. You will find the syphon discussed in books of civil engineering such as Trautwine's, price $5.00. Your friend is quite correct in his statement that water cannot draw water along in a pipe, since water is almost destitute of cohesion. The altitude of your place will reduce the height of the syphon about 6 feet, so that you can raise the water only 22 to 24 feet, according to the height of the barometer at the time. You cannot raise water by a syphon any higher than it may be raised by an ordinary lifting or suction pump at the same time and place. Any claim to have raised water 60 feet by a simple syphon is certainly an error.

(10643) C. E. B. writes: 1. In your answers to Query No. 10489, C. E. B., I think you have slightly misunderstood question 2. I did not mean the magnet to carry the armature as a hook would, but to lift or attract it to itself. The argument I wished the questions to settle was this: A says that if the armature of a permanent magnet is taken off by sliding it from the poles to the neutral part it will need less total energy to remove it than the magnet expended in drawing it up. Therefore, if the magnet in the question would, even in theory, go on lifting the armature forever, it would give out more work than was ever put into it, and that is impossible. B thinks that the magnet merely acts as a spring. When the armature is drawn off, it is like stretching the spring, and when released it springs back into place. He cannot, however, give any clear theory to explain the "stretching." They would like you to decide which is nearer the mark. A. The modern conception of a magnet is that of elastic and self-repellent lines of force passing out of the positive pole and returning through the magnet by way of the negative pole to their starting point. When an armature comes near the magnet, these lines of force enter the armature because iron presents less resistance to their passage than does any other known material, and because of the elasticity of lines of force the iron is pulled to the magnet. When the armature is pulled off, the lines of force are stretched until they break. The pull necessary to break them is obviously equal to their pull in the opposite direction when they pulled the armature toward the magnet. We do not see that the direction of the pull makes any difference. Sliding the armature along the magnet only changes the direction of pull and not its quantity. The same lines of force are ruptured in each case. No adhesion exists between the magnet and its armature. We are unable to think that there is any less force required to remove the armature than the magnet has exerted in drawing it to itself, since all the force there is in either case is due to the magnetic lines which the iron of the armature is capable of containing at the degree of magnetization which the magnet possesses. We do not think A is right in his position. B has an indefinite idea that something stretches, and that is correct. Lines of magnetic force stretch and this requires work. When the lines of force give way, the magnet returns to its original condition. B is more nearly correct than A is. 2. There seems to be great difficulty in making telescope object glasses over about 40 inches. Would it be possible to arrange a number of small glasses, say six 30-inch, in a circle, all focused, by means of prisms, on a common eyepiece and so adjusted that all the images coincide? A. It would seem impossible to adjust images from several lenses so as to produce a well-defined image in an eyepiece common to all the lenses. It is difficult to do so with even two or three lenses in projecting upon a screen in the three-color process of projecting pictures in natural colors. It would be much more difficult if an accurate magnification of the combined images were to be made.

NEW BOOKS, ETC.

ELEMENTS OF ELECTRIC TRACTION FOR MOTORMEN AND OTHERS. By L. W. Gant. New York: D. Van Nostrand Company. 8vo.; cloth; 217 pages, illustrated. Price, $2.50.

Electric traction is a branch of electrical engineering of the greatest importance, and an intelligent understanding of its principles by motormen and men of similar connection with its practice makes for greater public good. The "Elements of Electric Traction" is based upon a short series of lectures and practical demonstrations given during the last two years to a class of motormen and others at the Leeds Institute Technical School. It is designed as an introduction to the more advanced works on the subject, and as a supplement to the various handbooks that have from time to time appeared.

The elementary principles of electricity, magnetism, and the related phenomena are explained in the first chapters of the treatise, before going on to the headings more germane to the title.

The style of the work is very clear and lucid, and although the treatment is simple, nothing is lost in needless repetition.

THE MARINE STEAM TURBINE. Second Edition. By J. W. Sothern, M.I.E.S. New York: D. Van Nostrand Company, 1906. Cloth; 158 pages; 8¾ by 5¼ inches; numerous figures and illustrations. Price, $2.50.

The marine steam turbine is receiving more respectful treatment from marine engineers, since it has proved itself to be the successful rival of the reciprocating engine. In fact it almost seems that the turbine will some day entirely supersede the older form, for it is the ideal type of power producer for the modern high-speed steamship.

The author, who has had exceptional chances of studying marine turbines from every point of view, has added in this, his second edition, more details relating to the practical construction and running of this type of engine than were contained in his excellent first edition.

The work contains numerous drawings and sketches explanatory of the text; in fact, the drawings alone would make the book one of great value. The text is arranged so as to most forcibly impress the mind without fatiguing the eye.

THE MOON IN MODERN ASTRONOMY. A Summary of Twenty Years' Selenographic Work, and a Study of Recent Problems. By Philip Fauth. Translated by Joseph McCabe. With an introduction by J. Ellard Gore. London: A. Owen & Co. 8vo.; cloth, illustrated. Price, $4.

When telescopes were first invented, they were naturally turned upon the nearest celestial object, our satellite the moon. After its more apparent features had been noted, the enthusiasm of the early investigators was di-

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rected to other bodies, and the deeper problems of our neighbor planet were left more or less untouched, owing to the very desultory manner in which they were attacked.

Mr. Philip Fauth has devoted a lifetime to the study of selenography, and has shown himself admirably fitted to distinguish the minute differences that the selenographer must be able to detect. His work is written in an agreeable style, and commands both the interest and the confidence of the reader. In spite of this there is in the last chapter a statement that seems to exceed "scientific probability." After saying that the moon is at a temperature of —273 deg. C., the theoretical "absolute zero," at which all molecular motion ceases, and that its surface is covered with ice, under which are seas of water, Mr. Fauth goes on to state that the waters have at times broken through the mantle of ice, and, by their ebb and flow, have melted depressions in it, making the so-called "walled plains." This seems highly improbable, for even if water could exist as a liquid at temperatures in the neighborhood of the "absolute zero," it is most unlikely that such an ebb and flow could take place, since in a liquid cooled below its freezing point, solidification is almost instantaneous when the solid phase of the compound is in contact with the liquid phase. At a temperature of —273 deg. C. a body of water, however large, would be cooled below its freezing point in a very short time interval, and freezing would be almost immediate. This would be more apt to result in the formation of mounds than of depressions.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending December 10, 1907.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Aerial vessel, G. Halliday ... 873,542
Air heater, A. H. Lovejoy ... 873,566
Amusement apparatus, Mangels & Brewster 873,570
Animal trap, Brendt & Sherman ... 873,117
Animal trap, F. M. Sletto ... 873,331
Animal trap, Carlson & Hedstrom ... 873,502
Animal trap, A. T. Sullivan ... 873,631
Article holder, E. E. Minard ... 873,133
Automatic switch, F. M. Hall ... 873,368
Automatic switch, F. X. Mantsion ... 873,572
Automobile, F. Bartl ... 873,405
Automobile bumper, R. W. Harroun ... 873,544
Automobile folding seat frame, J. M. Nolan ... 873,453
Automobile lubricating device, F. J. Ziegler 873,478
Automobile steering wheel pivot, H. S. Baldwin ... 873,147
Automobile wind shield, S. D. Hunter ... 873,047
Automobiles, combined heating and ventilating system for, N. W. Williams ... 873,399
Automobiles, coupling rod for the axles of, T. Rommel ... 873,092
Automobiles, number lantern for, F. C. Lame ... 873,316
Awnings, apparatus for laying out and marking round top, C. Diehl ... 873,352
Band brake, F. O'Brien ... 873,679
Battery connection, G. P. Blow ... 873,660
Battery grid, storage, J. Marx ... 873,382
Bayonet and side arm, A. Krull ... 873,054
Bearing for vehicles, spring, R. J. Edwards ... 873,221
Bearing, shaft, A. Sauer ... 873,097
Bed, J. J. Dunn ... 873,357
Bed, couch, F. S. Sprague ... 873,103
Beds, head rest for, J. G. Ryan ... 873,095
Bedstead side rail joint, metallic, G. M. Robinson ... 873,173
Beer racker, Lowy & Adelman ... 873,567
Belt fastener, F. Baxter ... 873,009
Bicycle attachment, J. J. Walters ... 873,278
Bin. See Store bin.
Binder and letter file, E. A. P. Wolf ... 873,282
Binder, loose leaf, J. E. Maclachlan ... 873,151
Binder, loose leaf, J. C. Dawson ... 873,417
Blocking and derailing device, Kenyon & King ... 873,377
Blow guns, dart for, C. E. Stivers ... 873,628
Boat, life, T. B. King ... 873,557
Boat, motor, Salo & Rukonen ... 873,614
Boiler, W. G. Ross ... 873,094
Bolt and nut cutter, combination, J. Backscheider ... 873,004
Book, loose leaf, H. M. Sturgis ... 873,106
Boring or drilling machine, W. Topham ... 873,637
Bottle cap fastener, G. A. Williams ... 873,646
Bottle capping machine, A. W. Cordes ... 873,022
Bottle capping machine head, G. Kirkegaard ... 873,245
Bottle indicating device, J. Casaccia ... 873,410
Bottle, non-refillable, H. Mindermann ... 873,155
Bottle, non-refillable, G. P. Vissas ... 873,472
Bottle stopper, J. Repetto ... 873,087
Bowling alley, C. Lufsky ... 873,252
Braiding machines, change gearing for, H. Janssen ... 873,698
Brake, O. M. Gould ... 873,367
Brake mechanism, K. Rushton ... 873,459
Brake operating attachment, H. L. Witherell 873,113
Braking, regenerative system for, W. I. Slichter ... 873,101
Brick, treating, A. Magoon ... 873,568
Bridle bit, J. Reichert ... 873,604
Bronze dust, machine for removing, A. J. Ford ... 873,529
Brush, adjustable cleaning, R. T. Gillespie. 873,308
Brush, blacking, E. C. Hudson ... 873,550
Buckle, Young & Hinkle ... 873,199
Buckle, C. E. Smith ... 873,464
Buckle, harness, E. I. Allison ... 873,000
Buckle, snap fastening, G. A. Holmes ... 873,128
Buggy top attachment, W. C. Neff ... 873,164
Building block, hollow, B. Cerutti ... 873,505
Building block or slab, reinforced, E. C. Poole ... 873,600
Building structure, composite, B. Cerutti ... 873,504
Bung starter, H. H. Ashenberg ... 873,116
Burglar alarm, C. Van Bergh ... 873,638
Button, J. C. & J. A. Doran ... 873,354, 873,355
Cabinet, kitchen, A. C. Kerr ... 873,440
Cable clamp, well drilling, C. F. Rigby ... 873,090
Cable joint, metal sheathed, C. W. Davis ... 873,215
Caisson construction, A. Z. McLeod ... 873,069
Calculating machine, C. J. Smith ... 873,181
Calendar, A. Anderson ... 873,696
Came, T. W. Morrell ... 873,067
Can. See Display can.
Can vent shielding machine, H. J. Douglass 873,519
Canning device, fruit, T. H. Raney ... 873,603
Candle molding machine, C. Nordfors ... 873,073
Candy making machine, round stick, R. S. Walters ... 873,396
Cap, E. Forman ... 873,122
Car and train pipe coupling, combination, J. W. Barth ... 873,288
Car and train pipe coupling, combined, J. W. Barth ... 873,287
Car door, G. W. Sayre ... 873,175
Car, dumping, J. H. Blake ... 873,149
Car fender, street, M. Wilenski ... 873,197
Car, log or lumber, M. M. Russell ... 873,685
Car, motor, J. T. Hepburn ... 873,434
Car side bearing, J. C. Barber ... 873,404
Car ventilating system, passenger, N. S. Mercer ... 873,153
Car wheel, J. H. Woodworth ... 873,477
Cars, metallic window frame for steel, J. S. Doyle ... 873,218
Carbureter, A. E. Stoker ... 873,392
Cards for lace machines, machine for punching jacquard, H. Carbonnelle ... 873,293
Carriage running gear support, baby, W. C. Willets ... 873,196
Carrier, Leidal & Ulring ... 873,380
Carving fork, J. F. Brower ... 873,150
Casket handle, J. D. Lawrence ... 873,563
Catheter user's portable mechanical assistant, J. F. Spalding ... 873,275
Centrifugal separator, J. W. Phillips ... 873,593
Chain rope or belt, C. H. Bryan ... 873,208
Chair support or prop, Rothfuchs & Bliss ... 873,612
Chalk line holder, A. B. Sharp ... 873,686
Christmas tree holder, J. T. Bailey ... 873,402
Cigar cutter, A. C. Gast ... 873,365
Cigar package, F. E. Derge ... 873,217
Cigarette making device, I. L. Conkling ... 873,350
Cigarette tipping machine, A. L. Boucher ... 873,014
Clay cutting tool, K. Busch ... 873,209
Cleaner handle, vacuum, A. P. Cranston ... 873,300
Cleaning device, H. Chapman ... 873,412
Cloth cutting machine, G. L. Ballard ... 873,285
Cloth shrinking machine, C. W. Fenner ... 873,224
Cloth shrinking machine, A. Bloch ... 873,656
Clothes line hook, A. H. & A. J. J. de Beaumont ... 873,488
Clutch, W. W. Sly ... 873,102
Coal drill supporting frame, W. H. Clarkson ... 873,019
Coal hoist, electrically operated, Henderson & Bassett ... 873,312
Cock, time controlled gas, A. Davis ... 873,026
Coil support, field, E. T. Mug ... 873,160
Coin receptacle safety device, J. Nutry ... 873,678
Coke oven door jamb, E. H. Abraham ... 873,479
Collar dampening and folding device, E. G. Skinner ... 873,179
Comb cementing clamp, F. J. Patnod ... 873,077
Compost digger and elevator, G. Noll ... 873,260
Concrete construction, subaqueous, F. R. McQueen ... 873,581
Concrete tile mold, W. S. Thomas ... 873,634
Concrete work mold, F. M. Stults ... 873,138
Condenser, electric, F. S. Koch ... 873,053
Confectionery, article of, G. Heppe ... 873,369
Control system, Darlington & Schairer ... 873,351
Cooking utensil, Loudenslager & Morris ... 873,672
Copper and other metals, electrodeposition of, S. O. Cowper-Coles ... 873,508
Core box, W. F. Rice ... 873,170, 873,684
Cork grinding or finishing machine, H. F. Busch ... 873,498
Corn husking rolls, A. Rosenthal ... 873,610
Corset, J. Lindauer ... 873,443
Corset, apparel, A. H. Benjamin ... 873,489
Cotton chopper, H. P. Mizell ... 873,255
Cotton chopper and cultivator, Higgs & Hamilton ... 873,548
Crate, knockdown, A. Williman ... 873,645
Crate, metallic, J. Repetto ... 873,086
Crate or case for bottles, jars, and the like, metallic, J. Repetto ... 873,085
Cross arm and insulator therefor, wire carrying, E. C. Ottinger ... 873,456
Cross head, P. Langer ... 873,561
Cultivator weeder attachment, S. A. McCune 873,383
Cultivator, wheeled, J. S. Kendig ... 873,376
Curtain support and hanger, J. Garret ... 873,038
Curtains, automatic uncoupling handle for vestibule, H. M. Robertson ... 873,091
Cutlery, table, W. H. Smith ... 873,274
Cutting out circular or elliptical forms, machine for, C. C. Wais ... 873,395
Damper, A. W. Walker ... 873,141
Delivering articles of manufacture from a collecting receptacle, device for automatically, P. Raabe ... 873,268
Dental broach, C. A. Skalstad ... 873,100
Dental chair, A. W. Browne ... 873,015
Derailer, M. C. Sloderbeck ... 873,622
Derrick, E. E. Jenkins ... 873,374
Detinning, E. A. Sperry ... 873,699
Digger. See Compost digger.
Directory, telephone, C. E. Napp ... 873,259
Display can, sheet metal, F. Rudolphi ... 873,137
Display card rack, F. L. Stone ... 873,184
Display device, C. C. Fleming ... 873,421
Distribution system, J. B. Taylor ... 873,107
Door attachment, screen, C. S. McElroy ... 873,580
Door check, J. S. Young ... 873,693
Door closer and check, W. K. Henry ... 873,433
Door, grain, W. H. Ascue ... 873,115
Door hanger, J. W. Harris ... 873,230
Door hanger track, P. A. Myers ... 873,068
Door operating mechanism, R. F. Le Brocq 873,058
Door, rolling, J. Erwood ... 873,359
Double flange trap and sink, G. E. Dunstan 873,120
Dough dividing machine for bread making, G. T. Pendrith ... 873,682
Drawer support, C. A. Gehne ... 873,225
Drawing instrument for parallel ruling, T. English ... 873,524
Drill, S. Lake ... 873,056
Drying and ventilating system for houses, factories, or buildings, G. Muller ... 873,450
Dumb bell, magneto electric, J. Moores ... 873,066
Dump bed, automatic, C. C. Taylor, et al ... 873,187
Dust collector, G. H. Forsyth ... 873,532
Dust pan, S. C. Courtney ... 873,213
Dyeing, Waldinger & Iserloth ... 873,277
Dyeing, H. Toepfer ... 873,636
Easel, photograph, H. C. Itter ... 873,050
Eaves strip, W. Behl ... 873,407
Eaves trough support, C. H. Molyneux ... 873,578
Edger, G. M. Hinkley ... 873,667
Electric accumulator, Marino & Barton-Wright ... 873,132
Electric apparatus, H. L. Beach ... 873,290
Electric cable, C. W. Davis ... 873,216
Electro circuit controller, W. A. Paris ... 873,263
Electric heater, M. Landry ... 873,317
Electric machine, dynamo, J. E. Noeggerath ... 873,072
Electric machine, static, W. C. Shinn ... 873,178
Electric wires, rotating bracket for the suspension of, C. E. Buckbee ... 873,700
Electrical apparatus coil, P. MacGahan ... 873,253
Electrical drop, G. J. Galbraith ... 873,307
Electrical testing system, H. E. Miller ... 873,674
Elevated carrier, A. H. Neller ... 873,165
Elevator bucket, A. W. Berkner ... 873,655
Elevator safety appliance, S. Bruce ... 873,495
Ellipsograph, N. D. S. K. Beck ... 873,291
Engines, intake device for explosive mixtures in vapor, C. P. Hollister ... 873,372
Engraving machine, E. Bausch ... 873,008
Entrail cleaning mechanism, H. Hakenholz ... 873,311
Envelop, B. Davis ... 873,416
Envelop and letter sheet, combined, C. A. W. Westholm ... 873,691
Envelop blank gumming mechanism, Heywood & Travis ... 873,370
Envelop manufacturing machine, M. R. Dunnebier ... 873,520
Eraser, blackboard, M. W. Perkins ... 873,327
Eyeglasses, Webster & Ingold ... 873,109
Eyeglasses, L. B. Becker ... 873,342
Eyeglasses, W. L. Bemis ... 873,343
Eyeglasses, nose guard for, G. A. Bader ... 873,339
Fan, T. M. Mulkerins ... 873,257
Fan, A. Sakovitch ... 873,460
Fastening device, M. F. MacNelly ... 873,063
Fastening device, J. Senn ... 873,271
Fastening means, A. L. White ... 873,692
Fat cutting machine, E. E. Motter ... 873,256
Faucet, J. W. Grantland ... 873,538
Feeding mechanism, O. Ashton ... 873,338
Fence structure, N. B. Dixon ... 873,353
Fence, wire, G. L. Langer ... 873,318
Fertilizer distributer, Hill & Coleman ... 873,236
File, arch, W. O. Gottwals ... 873,537
File box, T. A. Walsh ... 873,473
Filter bed cleaning machine, H. W. Blaisdell ... 873,010
Filter press, F. B. Anderson ... 873,482
Filtering apparatus, liquid, Reeves & Bramwell ... 873,458
Fire extinguisher, automatic, W. G. Asmus 873,651
Firearm, magazine, J. J. Henry ... 873,547
Firearm sight, Windridge & Wilcox ... 873,112, 873,281
Firearms, light projecting attachment for, C. R. Penfield ... 873,591
Fish hook, trap, J. Hartshorn ... 873,23 1
Flat iron, C. G. Avery ... 873,202
Float fabric, G. W. Knox ... 873,378
Floor finishing and smoothing machine, G. P. Billings ... 873,207
Flushing device, automatic, Kadow & Lyons 873,55 4
Fob and purse, combined, R. Heine ... 873,431
Focusing attachment, E. S. Ballou ... 873,204
Folding table, form, and the like, W. & W. J. Cassels ... 873,118
Foot rest, C. P. Earley ... 873,521
Fork. See Carving fork.
Fowl beheading device, H. H. Holdren ... 873,436
Fruit picker, B. Hestness ... 87 32 34
Furnace door and device for opening the same, automatically closing, E. R. & J. Markmann ... 873,573
Furnace grate, H. C. Chamberlin ... 873,411
Furnace shaft, roasting, G. B. Shipley ... 873,687
Galvanic battery, reversible, T. A. Edison 873,220
Game board, Doan & Hanson ... 873,031
Garden reel, R. D. Wirt ... 873,143
Garter slide, J. Maltby ... 873,445
Gas, apparatus for carbonizing coal for the production of, Young & Glover ... 873,647
Gas burner, Springer & Maloney ... 873,182
Gas burner, J. Ball ... 873,485
Gas burner, J. W. Farnoff ... 873,525
Gas burner, Springer & Maloney ... 873,624
Gas generator, acetylene, T. J. Beaudette ... 873,406
Gas generators, carbid feed mechanism for acetylene, A. E. Schlieder ... 873,176
Gas manufacture, H. I. Lea ... 873,250
Gas or steam separator, J. E. Angell ... 873,336
Gas producer, C. Gamer ... 873,037
Gas producer, A. J. Gifford ... 873,039
Gasket and making the same, closure, J. S. Giles ... 873,366
Gate, E. L. McMichael ... 873,135
Gear, change speed, Sizaire & Naudin ... 873,461
Gear, friction draft, J. R. Cardwell ... 873,210
Gem displaying ring, C. Moe ... 873,156
Glass grinding, smoothing, and polishing machine, plate, E. Bagnall ... 873,340
Glove, apparel, B. J. Ricker ... 873,608
Go-cart, collapsible, J. Wolfenden, et al ... 873,283
Golf club, J. Govan ... 873,423
Goods composed of cotton and wool, production of effects on mixed, G. Rudolph ... 873,613
Grain shocking apparatus, J. Calder ... 873,500
Grave protector, G. H. Knochel ... 873,052
Gridiron, A. C. Parry ... 873,589
Grinding machine feed regulator, T. A. Edison ... 873,219
Grinding or polishing wheel, C. B. Wattles 873,398
Grooving and jointing machine cutter head, H. B. Ross ... 873,093
Ground plate, B. J. Jones ... 873,375
Grout mixing and discharging apparatus, pneumatic, W. L. Canniff ... 873,345
Gun case and ammunition belt, combined, N. T. Veliquette ... 873,140
Gun sight, Garrison & Hillis ... 873,535
Hair pin, D. W. McNeil ... 873,163
Hammock support, C. H. Banks ... 873,652
Harness hanger, F. Hof ... 873,549
Harvester, beet, M. Goodfellow ... 873,040
Harvester knotter, R. H. Moore ... 873,158
Hat fastener, M. F. Laubach ... 873,057
Hat holder, R. W. Bock ... 873,490
Heel, detachable, C. C. Schmidt ... 873,388
Hides and making same, substance for treating, O. H. Nowak ... 873,074
Hides and skins, carroting, C. & E. Pichard ... 873,594
Hinge, door, W. K. Henry ... 873,432
Hoeing machine, W. A. Harris ... 873,543
Hog catcher and holder, J. Davis ... 873,514
Hoisting apparatus, A. G. Monks ... 873,157
Hoof parer, J. Hedrick ... 873,546
Hook rod disconnecting device, Allison & De Wein ... 873,695
Hoop. See Metal hoop.
Hop jack, O. Selg ... 873,330
Hop wire detaching device, J. A. Grover ... 873,227
Horse detacher, Peterson & Haines ... 873,592
Horse gaiting device, E. A. Hyde ... 873,240
Horseshoe, R. Hubner ... 873,373
Horseshoe, H. J Ross ... 873,611
Horseshoe calk, Courtney & Bornhorn ... 873,119
Hot air furnace, A. C. Mott ... 873,449
Hot water boiler, H. Wilson ... 873,111
Hub, vehicle, A. Hart ... 873,428
Hydrometer testing jar, F. Storm ... 873,629
Ice machine, Tobey & Freeman ... 873,189
Illusion device, A. K. Massaad ... 873,447
Incubator, J. E. Chambers ... 873,295
Index, card, E. Eckart ... 873,305
Instep support, F. N. McKinnon ... 873,677
Insulated rail joint, J. H. Brothers ... 873,492
Internal combustion engine, A. M. Brown ... 873,493
Internal combustion engine, H. S. Anderson ... 873,650
Invalid lifter, Olsen & Johnson ... 873,076
Iron from metallic sulfids, making, R. H. Aiken ... 873,648
Jack or lifting device, Lagasse & Normand 873,248
Joining device, H. Pohlmann ... 873,599
Knife polishing machine, G. S. Blakeslee ... 873,011
Knife switch, H. P. Ball ... 873,005
Ladder, extension, W. Williamson ... 873,110
Lamp, A. H. Handlan, Jr ... 873,427
Lamp, arc, W. E. Daniels, ... 873,414, 873,415
Lamp burner, Fain & Henry ... 873,360
Lamp, gas, E. W. Cornell ... 873,663
Lamp holder, electric, Throop & Freeman ... 873,108
Lamp receptacle, J. S. Stewart ... 873,104
Lamp shade, folding, V. Freytag ... 873,665
Last, H. F. Loewer ... 873,060
Last, J. P. Thurell ... 873,635
Lasting machine, J. Cavanagh, Jr ... 873,018
Latch, door, J. H. Stratton ... 873,185
Latch hook, E. A. Hill ... 873,235
Leather, manufacturing artificial, L. Gevaert-Naert ... 873,582
Lifting and moving jack, combined, A. W. Whiteford ... 873,194
Linotype machine, G. G. Babcock ... 873,203
Linotype machine, Libby & Babcock ... 873,251
Linotype slug receiver, G. E. Wallin ... 873,642
Liquid dispenser, J. Fitzpatrick ... 873,306
Loading jack, lumber, G. Rypkema ... 873,096
Lock, A. Cordeau ... 873,212
Lock, F. S. Aliano ... 873,481
Locomotive, N. D. Levin ... 873,442
Locomotive driving boxes, wedge for, W. J. Barrett ... 873,148
Log finder and lifter for submerged logs, etc., J. M. Munn ... 873,579
Looms, lay motion for, A. E. Rhoades ... 873,606
Looms, rotary magazine for weft replenishing, M. L. Stone ... 873,467
Looms, wire head and fastening means for, Mitchell & Beal ... 873,448
Lubricator, W. & J. W. Leyland ... 873,319
Machine frame, long, W. D. Richter ... 873,088
Mail deliverer and receiver, O. Fisher ... 873,527
Mail pouch receiving and delivering device, B. Stanley ... 873,276
Mail receiver, A. F. Kuhl ... 873,247
Mantle holder, Welsbach, C. R. Warner ... 873,690
Manure spreader, Dennis & Rice ... 873,030
Manure spreader, C. W. Smith ... 873,465
Marble, making artificial, E. E. Hippe ... 873,371
Massage implement, H. D. Gardy ... 873,123
Measuring and cutting skirts, machine or device to be used in, V. A. Phoebus ... 873,266
Measuring machine, cloth, L. P. Normandin 873,454
Mechanical movement, L. Griffith ... 873,426
Messages, signals, etc., apparatus for receiving and strengthening the reproduction of, E. S. Hagemann ... 873,042
Metal hoop, J. E. Wright ... 873,114
Metals, making a solution of rare earth, C. Baskerville ... 873,205
Metallic chair, J. H. Petroskey ... 873,265
Metallic tie, W. D. Turner ... 873,469
Meter, E. Schattner ... 873,098
Meters, prepayment attachment for electricity, F. J. Dowling ... 873,356
Micrometer gages, etc., spindle lock for, Starrett & Adell ... 873,626
Microscope, E. Bausch ... 873,007
Microtome, H. Lebrun ... 873,059
Microtome, R. H. Pietzsch ... 873,595
Mill. See Rolling mill.
Mixing fluids and molten metals of different densities, device for, H. Leiser ... 873,131
Mixing machine, Stockham & Doyle ... 873,391
Mold attachment, H. A. & H. W. Keehn ... 873,670
Molding machine, J. H. Koontz ... 873,559
Molding machine, H. Pocock ... 873,598
Molding process, A. B. Marsteller ... 873,574
Monkey wrench, C. & G. C. Van Horn ... 873,191
Mortar mixer, C. E. Oelman ... 873,455
Motor, J. Schroeder ... 873,619
Motor control, electric, W. Cooper ... 873,298
Motor control system, W. L. Merrill ... 873,064
Motor control system, W. J. Richards ... 873,171
Motor control system, W. F. Schneider ... 873,177
Motor control system, electric, L. M. Aspinwall ... 873,284
Motor controller, electric, W. A. Paris ... 873,264
Motor starting and controlling apparatus, electric, A. Taylor, et al ... 873,139
Mounds, graves, and other similar purposes, cover for decorating, C. Weber-Illig ... 873,279
Mouse trap, J. A. Vincent ... 873,639
Mower, lawn, T. J. Dunning ... 873,033
Mower, lawn, I. Ellwood ... 873,523
Music cornet, automatic sheet, Fauth & Skamper ... 873,035
Music playing instrument, autopneumatic, W. R. Crippen ... 873,214
Music sheet holder, F. W. Barrows ... 873,286
Musical instrument, J. A. Bartholomew ... 873,289
Musical instrument keyboard, A. E. Adriance ... 873,146
Musical instrument, mechanical, F. G. Lynde ... 873,320
Newspapers and the like, conveyer for, E. G. Thomas ... 873,633
Nozzle, Cummings & Hanna ... 873,301
Nut, axle, N. H. Roe ... 873,386
Nut lock, F. Greene ... 873,424
Nut lock, A. H. Reade ... 873,457
Ores, chloridizing, J. E. Greenawalt ... 873,309
Ores from the rocky constituents thereof, apparatus for separating the metallic particles of, D. H. Norris ... 873,586
Ornamental article for personal wear, M. E. McDonnell ... 873,258
Oven, portable, A. B. Kingsland ... 873,558
Overshoe, J. D. Price ... 873,602
Package tie, O. S. White ... 873,192, 873,193
Packing, metallic, E. M. Cook ... 873,507
Pail and heater, dinner, E. F. Hayes ... 873,232
Paper box, G. R. Wyman ... 873,335
Paper coating or treating machine, H. P. Hilbert ... 873,126
Paper sacks and roll paper, combined holder for, W. E. Burks ... 873,409
Paper softening apparatus, T. Scherf ... 873,169
Pencil sharpener, A. T. Peterson ... 873,079
Phonograph, Bornand & Thoens ... 873,013
Photograph cabinet or rack, J. N. Koch ... 873,379
Photographic flash lamp, J. Inglis ... 873,242
Piano sling, H. H. Hanson ... 873,044
Piling, compressed air cushion block for, C. C. De Witt ... 873,517
Pipe bending machine, J. F. Cox ... 873,023
Pipe threading machinery, Westrip & McCarty ... 873,334
Pipe wrench, J. L. Brown ... 873,494
Planers, work support for bottom cutter heads of wood, Blood & Osteman ... 873,657
Planter, corn, C. E. Mentzer ... 873,673
Platen gage, O. V. Stapp ... 873,183
Plow, auto steam, C. G. Hampton ... 873,229
Pneumatic despatch apparatus, E. A. Fordyce ... 873,531
Pneumatic despatch tube apparatus, A. W. Pearsall ... 873,590
Pneumatic despatch tube apparatus, terminal for, I. W. Litchfield ... 873,565
Pneumatic tube apparatus carrier, E. A. Fordyce ... 873,530
Pocket knife, H. Berns ... 873,206
Pole, sheet metal, W. L. Wright ... 873,144
Polishing machine, C. M. Nichols ... 873,583
Porch cleaner, M. Mueller ... 873,451
Postal mailing card, D. W. Custer ... 873,024
Powdered substances, receptacle for, Y. K. Buell ... 873,497
Power transmission mechanism, J. H. Pendleton ... 873,681
Pressure, machine for exerting, E. P. Guenther ... 873,539
Pressure tank, Lewis & Smith ... 873,671
Printer's registering device, F. C. Dohrmann ... 873,303
Printing attachment for paper roll holders, J. L. Lamboley ... 873,560
Printing film frames, film frame rest for, B. Day ... 873,029
Printing machine, duplicating, B. O. Fanslow ... 873,361
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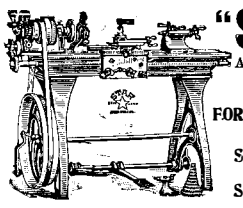

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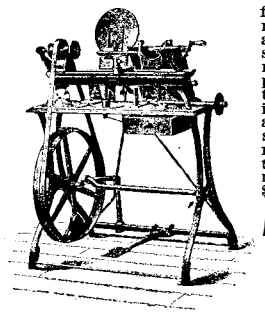

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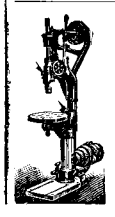

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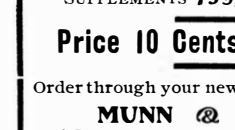

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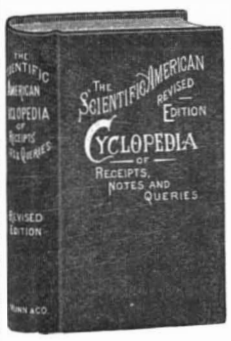

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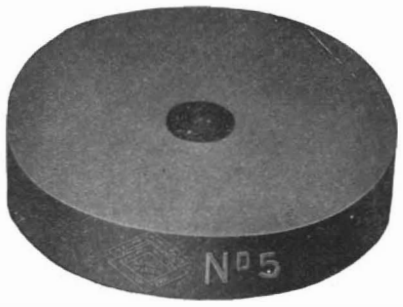

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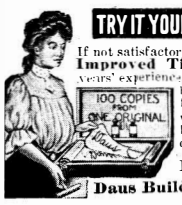

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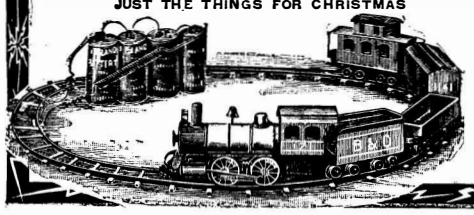

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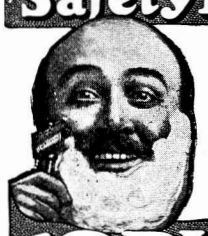

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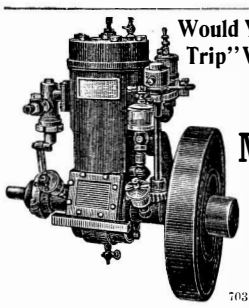

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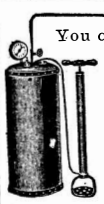

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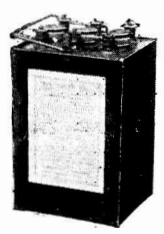

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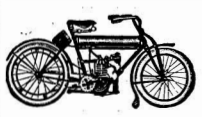

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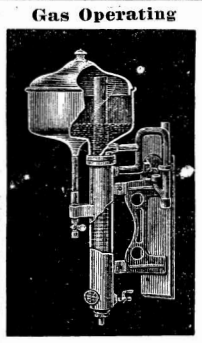

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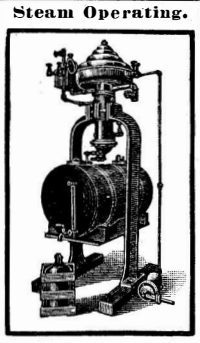

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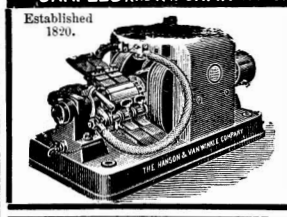

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